Engineering Record

A Weekly Journal Devoted to Civil Engineering and Contracting

Published by McGraw Publishing Company, Inc.

Volume 70 NEW YORK, SATURDAY, OCTOBER 3, 1914 Number 14

The Wooden Bleacher—A Warning

THIS journal has on numerous occasions called attention to the necessity for the careful inspection of timber grandstands, particularly before the opening of the baseball and the football seasons. If these warnings have fallen on deaf ears, possibly the striking photographs on page 377 will convince the skeptical that there was good reason for this journal's preaching. Here was a stand accommodating over 5000 people, many members of which could carry very little load. What obtained at Madison will undoubtedly be found also at other colleges and on athletic fields generally. Now is the time for action. The football season is opening and grandstands will be crowded to capacity. The impact of thousands suddenly coming to their feet to cheer a long field goal or a spectacular end run will throw heavy stresses on the supporting members. Unless they are sound, disaster may result. It is supposed, of course, that the original construction was satisfactory; that the bracing, wherein defects in design are generally found, is ample. It is worth noting, too, that the treatment of the timber in this structure would have cost but little and would have been amply repaid in longer life and greater safety. The subject is too important to be lightly regarded, and if the warning is to be of any value it should be heeded at once.

The War and Fire Prevention

FIRE prevention propaganda need no excuse at any time but they are especially opportune at present when a serious fire loss might easily rend the very delicate fabric of financial and commercial credit on which fire insurance stability depends. The Chicago Fire Prevention Committee is sending out literature calling the attention of business interests to the vital importance in the present war crisis of taking every possible precaution against fire. More firms should, like Marshall Field & Company, of Chicago, are doing, instruct heads of departments and managers of factories, warehouses, and garages to be exceptionally careful and point out to them how much more serious a fire loss would be at present than in normal times. The insurance companies would be embarrassed by the difficulty in selling securities, owing to the closure of the stock exchanges, possibly preventing reconstruction for some time. Moreover, it was never more desirable than now to keep business going, not only for the good of the employer, but also of the employee. Engineers in charge of building inspection can help materially to this end by insisting on stringent interpretation of fire prevention regulations and thorough examination of the properties in their jurisdictions.

Fake Engineering Companies

WARNING was given in this journal early this year of the activities of a number of stock-selling engineering companies, whose chief engineering work consisted in devising ways and means to mulct those who got into their toils. A certain crew has operated under the names of the United Engineering & Construction Company, of Cleveland, Flynt & Company, Inc., of Chicago, and the Industrial Organization Company, of the latter place. Now evidence has been secured against one of the officers, a certain Theodore Rodmann, who is being held to the United States Grand Jury which meets in Chicago this month. While the requirement that a prospective employee invest a certain amount of money before being given a position is an entirely legitimate one, provided he is to share in the benefits, the operations of fake organizations within the last few years has tended to cast suspicion on all such offers, particularly when made through advertisements. As evidence of this suspicion the Engineering Record within the last month has received letters from two engineers in the Southwest who have been made such offers by companies in Oklahoma and Arkansas respectively. The Engineering Record has been unable to learn whether these companies are legitimate or not, but has advised its correspondents to proceed very cautiously and not to invest their money until they are certain of the standing of the companies. Engineers will do well to spread the news of the operation of these fakers as widely as possible.

Boston's New Subway

AN addition to the Boston subways, scheduled for opening Oct. 3, provides a new rapid transit route through the Back Bay district and in point of time brings the Allston, Newton and Brookline suburban sections seven minutes nearer the business center. The Boylston Street subway, as the new tube is called, enables the Boston Elevated Railway to withdraw a large percentage of its present surface cars from the most congested trackage of the system, when judged by the number of cars operated during the rush hours. A complete equipment of automatic block signals and liberal station accommodations, including plans for the early enlargement of the Park Street station, are features worthy of note. With stops at Copley Square and Massachusetts Avenue and the usual liberal transfer arrangements characteristic of Boston transit administration, local trafic is well cared for. From the engineering standpoint, the most important problem encountered was the protection of the foundations of the Old South Church tower in Copley Square. The thoroughness with which this task was accomplished reflects credit upon the Boston Transit Commission and the section contractor. Subway building has become in a sense a matter of routine in Boston, and if the work completed every year or so lacks the extent of that under way in New York, it nevertheless fulfills a highly useful object and exemplifies in each addition the progressiveness of the pioneer underground transit system of the country.

The Business Situation

THERE is no doubt that a more optimistic tone prevails to-day with reference to the immediate business future than obtained a week or ten days ago. So great is the European catastrophe, when measured by its cost in money and men, that it shook business to the very foundation. Never before in history has such a crisis been faced, and naturally it has taken some time to evaluate the various factors and enable a fair view to be taken of the situation. The darkest pessimism reigned during the first month of the war. With September calmer views prevailed and now business men quite generally are looking forward toward quite normal business in the near future. Undoubtedly crop conditions in the West will aid materially. Early in September it was practically impossible to secure loans. Now the country banks are taking up their obligations discounted in the big centers and in a short time will be in the market for commercial paper. This movement is bound to have an immediate influence in the Middle West and the effect should travel eastward very quickly. New York, as the money center of the country, naturally took the darkest view of the financial situation. By contrast the Pacific Coast never lost its optimism. But now even New York sees the silver lining of the war cloud. The New York Times well summarized the situation on Sept. 28. "Prosperity," it said, "is here for those who know it when they see it. . . . Prosperity also is in the active mind of the individual who has the brains and the initiative to see an opportunity and make it his own. There is trouble ahead for those who are looking for it. There is prosperity ahead also for those who prefer it." Certainly the initiation of the manufacturer in this country of lines formerly bought abroad will tend to offset the losses in our export trade. The Amoskeag Company has announced that it will build the largest cotton bag mill in the world, to replace the jute product now cut off from our markets; Mr. Edison has discovered a method for making carbolic acid from native raw materials, while in other lines similar efforts are being made to supply home demand with native substitutes for articles formerly imported. There is reason, therefore, for the new optimism.

A Dangerous Decision

A DECISION that should be vigorously combated was handed down Sept. 22 by the Frederick (Md.) County Court. Under a law passed by the last Legislature, making it a misdemeanor for traction engines with exposed cleats to use the State highways, the State Roads Commission sought an injunction against infraction by machines in that county. Engine owners objected on the score of added expense and also claimed that it was not possible to operate tractors on steep grades with sheathed cleats. Officials of the State Commission then offered to fit any traction engine with guard blocks and drive it over every State road in the country, drawing a threshing machine. This offer was refused, and the prayer for injunction was dismissed by the court. The astonishing reason given for the decision was that the highways should have been designed to withstand the assaults of the tractors, which were prior users of the roads. A parallel existed, it was said, in the adoption of bituminous treatment because of the demands of automobile traffic.

This false logic appears plausible enough, so that what is at present an unjust decision may become a dangerous precedent. Motor traffic in Maryland, as in other States, is subject to laws regarding weight and speed and the payment of license fees. These are equitable requirements. What the Frederick County Court has done is to set aside a tractor-regulation law as logical as those restricting general motor traffic. Bituminous surfaces in Maryland seem to be meeting legitimate strains efficiently. To expect them to carry heavy engines with unprotected wheels is an absurdity which should be evident to every intelligent Marylander. The road commission should appeal from this decision and should be upheld by all interested in the upbuilding of the State's highway system.

Reading Technical Journals

IN the qualifying tests of marksmanship which are now a regular part of our army routine, it is always instructive to stand behind a pair of men on the firing line at a rifle range and watch the effect of their shots. Rifles, ammunition, targets and range are the same for both, yet one will score an unbroken string of bull's-eyes and "four's" while the other will turn in a card of "three's," "two's" and "misses." The first man knows how to use his weapon; the second, with the same weapon, gets poor results.

These two soldiers are typical of two classes of readers of the technical journal. To each class the publisher sends the same sort of munitions in printed form each week. One will take this material and with it score effectively in his own work, while the other receives, comparatively, little benefit. In this issue John W. Alvord gives an instructive lesson in the use of the technical periodical. His paper was read last week before the Federation of Trade Press Associations in Chicago and is reprinted on page 375. He analyzes the cases of the young engineer, the mature reader, who "has no time to read," and the veteran with years of experience behind him. For each the modern technical journal has something to offer, if the reader will only take the trouble to learn how to find it. Mr. Alvord's paper is replete with helpful hints on what to read, what not to read and how to preserve engineering data for future reference.

The editor of to-day, in contrast with his predecessor of a decade ago, faces each morning an imposing mound of manuscript—far in excess of the space available for contributions—and from this he selects his articles. The field of civil engineering is so broad that a wide range of subjects must be covered by the paper which conscientiously serves all its readers. Manifestly every story will not interest every subscriber. In these days of specialization, therefore, the reader must learn to estimate the value of each article from the standpoint of his own needs and concentrate upon those which apply to his particular work. Technical journalism has by no means reached a stage which might be called perfection. Even an editor will admit this frankly, but the technical paper has established for itself a place in engineering progress and with the co-operation of its readers an even larger field of usefulness lies before it.

Putting Paving on a Systematic Basis

NEW ORLEANS has just begun work under a new paving law which represents improvement and progress toward the systematizing of city paving work. The essential features of the law are that prior to the first of September the city must make its plans for all the street paving that is to be done during the succeeding calendar year; after the bids are opened they are published for a month and the property owners are given an opportunity to petition for the type of pavement that they desire. Thereafter certificates are sold against the assessments for the work and the proceeds of the sale of the certificates are used to pay the contractors.

The assessment proceedings are to be finished before the beginning of the work, thus financing the property owners' portion and doing away with the troublesome tax lien. The bonds sold in anticipation of the collection of the property owners' share of cost rest not only for their security on the fund created by the assessment, but are made by law an obligation of the city and given a specific lien against the city's reserve funds. They may be sold as low as 95, thus facilitating their prompt disposal at times when the bond market is below normal. This amounts to making up in advance a plan covering the amount of paving to be done and types of pavements to be laid, as well as the financing of a year's work.

It is provided that bids are to be taken on a great many types of pavements, for which detailed specifications are legalized. These specifications include sheet asphalt, asphaltic concrete, cement concrete, rock asphalt, mineral rubber and wood block. The bituminous specifications draw a clear distinction between "oil manufactured asphalt street pavement" and "natural pitch asphalt street pavement." Competition is provided between the different types without making the attempt to cover all or any general class of materials or pavements in any one specification. No specifications are "closed," except those describing patented pavements.

Paving procedure is badly in need of reform and while it is easy to suggest improvements over the New Orleans plan, it is a step forward and, therefore, to be commended.

Welding the Organization Together

IN a large organization a man often becomes lost. This is especially true of engineering work, in which it is common for operations to extend over many miles of line. The result is that the little group of workers at one end performs its duties day by day, knowing practically nothing of what goes on beyond the confines of its own section. This condition tends to narrow a man's conception of his work, for he fails to appreciate how his portion, like a piece of a jigsaw puzzle, fits into the larger scheme. It is only by standing off at a distance that the relation of the different elements becomes apparent.

Of the various methods of broadening the employees' vision, none has found greater favor than the news bulletins, distributed periodically to all members of the staff. Some private corporations—railroads, telephone companies and large manufacturing organizations—have made the dissemination of information about their work and the men who do it a feature of their regular routine. On some public works, too, the same plan is in effect. Some of the more familiar news bulletins are the "Canal Record," the "Catskill Aqueduct News" (which has recently been discontinued, since the work is nearing completion), the "Reclamation Record" and the "Barge Canal Bulletin." Many of the State highway departments have similar publications. The scope of the "Reclamation Record" has recently been expanded, so that it is now an irrigation farmer's magazine as well as a bureau bulletin.

The latest addition to the list is the "Public Service Record," devoted to the interests of the engineering staff which is building New York's new subway system. The fourth number has recently appeared and contains articles on construction work, on the administration of the departments and bureaus of the Public Service Commission and progress statements for the contracts in force.

Information of this sort cannot fail to have an educational value, and it is sure to increase esprit de corps, which every chief engineer prizes above anything else. No one who has not been isolated on the far end of a great work can appreciate the interest that the men take in these periodicals. The arrival of the "Catskill Aqueduct News" in the division and section offices in the little towns of the upper Hudson River Valley was an event second only in importance to the coming of the paymaster. While the technical journals endeavor to record progress on the country's large engineering works, they do not take the place of the organization bulletin. The man behind the transit or the drafting board finds in his own periodical an atmosphere of intimacy which creates interest and pride in his work and makes for greater cohesiveness throughout the entire staff—for what military men, in speaking of the efficiency and loyalty of the men in the ranks, call the "touch of elbow."

Architectural Considerations in the Natural Lighting of Buildings

ONE of the important papers read at the recent convention in Cleveland of the Illuminating Engineering Society was a study by Messrs. Marks and Woodwell on planning buildings for natural illumination. In large cities the enormously high neighboring structures prevent adequate exposure of the windows to the light of the sky even when the window area itself is large. There is now a general tendency to restrict the height of buildings with respect to the streets on which they abut, and this in a measure relieves the lighting situation, although it does not in the least prevent very bad lighting in the courts and interior spaces common in modern office structures. As to the amount of light received from sun or sky this has in general terms been investigated to a degree of precision as great, at least, as the varying circumstances require.

The effect of this light in producing interior illumination of the rooms is the thing to which Marks and Woodwell have particularly directed their attention, and with interesting results. They show plainly not only the effect of general obstructions on the access of light to windows, as in the case of high neighboring buildings, but also the serious results that may follow architectural peculiarities, such as deeply recessed windows and ornamentation that casts heavy shadows. What is more important, they give a good and practical method of predetermining what the effect of structure, orientation and surroundings is likely to be.

Their principal study of the subject was made in connection with the proposed circular Court House for New York. One can, of course, compute the direction of sunlight with respect to the windows for all hours at any season of the year, including the effect of obstructions, but the scheme adopted by Marks and Woodwell is beautiful in its simplicity and much easier to carry out. It simply consists in constructing a rough pasteboard model to scale, showing the contours of the building and position of the windows. Above this model is arranged a wire frame representing the apparent paths of the sun for the various hours of daylight at the solstices and equinoxes. By directing a beam of light, projected from a small lamp, in accordance with the various directions of sunlight, it becomes possible to see the effect of shadows and to figure out the light received at any group of windows under average conditions throughout the year.

In studying a new building planted among other skyscrapers, the same plan applied to a rough model of the whole group will show very successfully the general conditions with respect to shadows and the probability of requiring artificial light during daylight hours. The authors point out by a very striking illustration the fact that in many office buildings a large part of the windows are so ineffective by reason of their exposure as to force the use of artificial illumination even at high noon.

The study of the new court house, which forms the basis of the paper, was of the most complete and searching character, but perhaps its greatest value was in the evolution of convenient and practical methods for the treatment of the general problem, quite aside from this particular application.

Durability of Cast-Iron Pipe

THAT the extreme term of usefulness of cast-iron water pipe has not yet been determined after two hundred and fifty years of experience, several pipe lines of that age being still in service, is one of many interesting statements concerning this widely used material made by Marshall R. Pugh in the August "Proceedings" of the American Society of Civil Engineers under the caption, "External Corrosion of Cast-Iron Pipe." In this paper the author has diligently assembled much information, new and old, from numerous sources, about the history of cast-iron pipe and its external attack. Metallurgical and chemical studies of the nature of cast iron, of its corrosion under various conditions and of means for avoiding or combating corrosion are reviewed at some length.

From the historical data collected a few facts may be cited; those who wish to pursue the subject will find references in the paper. It was not until the fourteenth or fifteenth century that the art of casting iron became known. Several cast-iron pipe lines, of various diameters up to 20 in., were laid at Versailles by Louis XIV between 1664 and 1688; they have bolted flange joints, are still in use, and so far as known are the first cast-iron water pipes. About 1785 Thomas Simpson, engineer of the Chelsea Water Company, London, designed and laid the first bell-and-spigot pipes with lead joints. In 1804 Philadelphia laid about ¾ mile of cast-iron pipe and soon had the first distribution system of this material in America. At the end of a century many of these pipes are still in service and apparently fit for years to come unless outgrown as to size.

On the other hand, deterioration of cast-iron pipe has been rapid under some conditions; in extreme cases small pipes have become useless within a few months. A few of these destructive conditions have been recognized for a long while, particularly those obtaining in salt marshes. Thomas Duncan, of the Liverpool waterworks, was one of the earliest writers (1853) to comment upon this phenomenon. Summarizing his observations on pipes which had been in service under various conditions for from 20 to 50 years, he states that in all instances the hardest pipes had deteriorated least, and were found cleanest on the inside. Some of the materials which are inimical to cast-iron pipe are saline soils, such as those in the vicinity of the salt springs at Syracuse, N. Y.; clay and ashes, or marl mixed with cinders; clay soil containing crystals of gypsum, and, possibly, the alkali soils of some of the semi-arid regions of America. More information is needed on the last point. Acids in soils from young roots, decaying vegetation and worms are also injurious to iron. Where low lands are filled with cinders, ordinarily no trouble need be feared, but when subjected to alternate wetting and aeration, precautions are advisable.

As a protection, the great resistance of the silicious foundry skin needs to be emphasized. On account of the inhibiting value of chromium in steel, Mr. Pugh suggests that chromite or some other compound be mixed with the facing sand of the molds. Extra heavy, or so-called double, galvanizing is believed to be a very effective protection. Another remedy is to utilize the protective influence of alkalis by surrounding the pipe with lime or cement, wherever practicable. Acids, salt and air should be excluded. In a few cases pipe lines have been supported above the surface of the troublesome soil and left exposed. Manifestly location, size of pipe, expense and convenience, and the importance of the line will determine which of several remedies are to be used in any case.

Galvanizing of wrought iron and steel pipes and other objects of iron and steel has been proved by wide experience through many years to be a thoroughly effective method of protection against corrosion, both when the objects are buried in the ground and when exposed to the atmosphere. To be enduring the zinc coating must be heavy and must be spared from abrasions during construction operations. It must be remembered, too, that zinc yields readily to many dilute acids, and that galvanizing would be considered prohibitively expensive for cast-iron pipes except in unusually difficult or important cases. Attempts to secure pipe of hard iron, or iron high in combined carbon, when made by one water department for a specially important line, met with discouragement from several leading pipe foundries. In some instances it might be found less expensive, or not much more costly, to lay a longer line around a troublesome piece of ground rather than to attempt to combat an aggravated tendency to corrosion.

In general, however, precautions against corrosion are unnecessary, and while the conditions which call for provisions should be fully understood by waterworks men, their occurrence is exceptional. In city work another factor—electrolysis—is far more dangerous than ordinary chemical corrosion and to its avoidance very active consideration needs to be given.

Mill Creek Sewer System in St. Louis—A $3,000,000 Pressure Tunnel Project

History of St. Louis Sewers, Details of Original Construction, with First Costs and Repair Charges, and Discussion of Early Projects for Relief—Part I

By W. W. HORNER and LELAND CHIVVIS
Principal Assistant Engineer / Engineer of Construction
St. Louis Sewer Department

IN awarding contracts for the improvement of the sewerage system of Mill Creek Valley the city of St. Louis, last August, embarked upon a project which will involve the expenditure of over $3,000,000. The principal feature of the improvement is a concrete-lined pressure tunnel in rock. This, the first of a series of three articles describing the work, deals with the development of the city's sewerage system since 1849, presents figures for first cost and repairs, and discusses the more important projects which have been proposed for the relief of the valley.

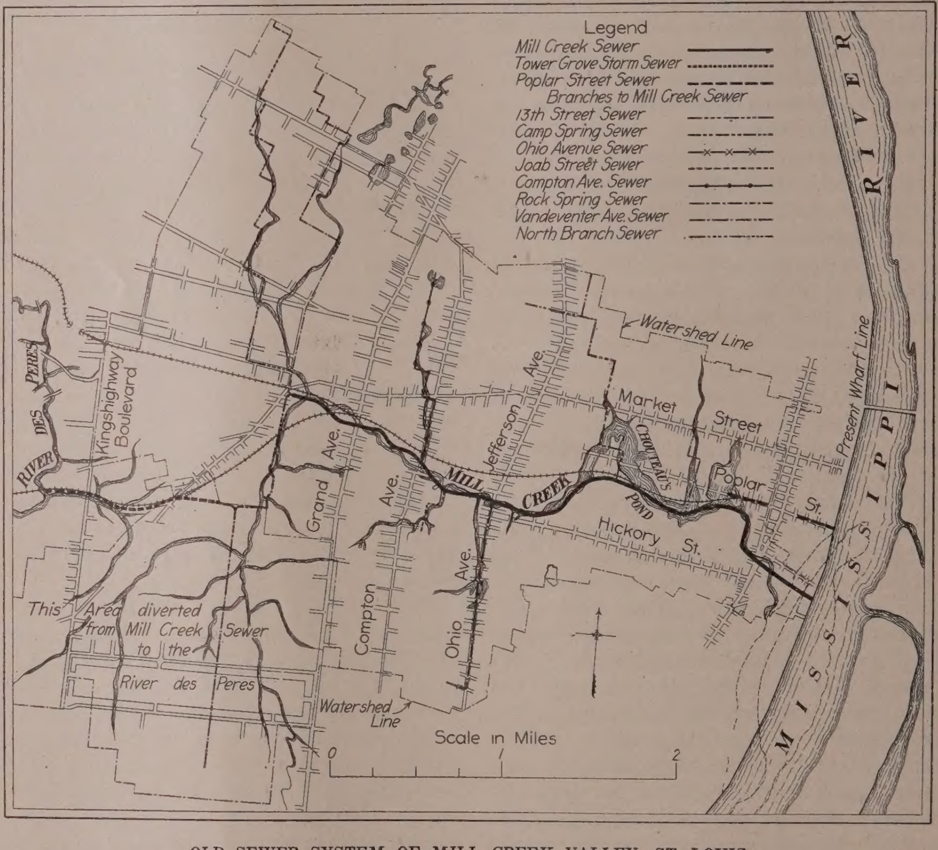
As a preparation for the study of sewer conditions in the Mill Creek Valley, St. Louis, a careful search through old records of the original sewer construction was made. These records are meager but a few items were found which throw light on the ideas of sewer engineering sixty years ago and on the enormous difficulties under which the engineers labored.

The sewer system of the city originated in 1849. Previous to that time only a few small drains had been constructed. Only the lower portion of the Mill Creek Valley was then in the city, Chouteau's mill pond being on the outskirts, and it is probable that the engineers of that time had no definite idea of the extent of the valley. The complete urban occupation of the whole watershed was never dreamed of.

HISTORY OF SEWER SYSTEM

The first sewer in the valley was the Poplar Street sewer. This sewer was begun in 1851 to drain the Chouteau Pond, but was evidently expected to take the whole flow from the Mill Creek. In 1853 the sewer had been completed from the Mississippi River to First Street and from Eighth to Ninth Street. Quicksand was encountered and little progress was made. In 1855 the contract was cancelled. Additional borings were made and the engineer estimated that it would cost about $135,000 to complete the work and would require 3 yr. work. In the meantime some work had been done to regulate the channel of Mill Creek and it was estimated that the completion of an open aqueduct along the creek channel would cost $66,000 (both figures evidently apply from the river to Ninth Street only). Comparatively little progress was made, however, and in 1860 the engineer again (comparisons had been made in 1858) compared the Poplar Street plan and the Mill Creek channel sewer. He then estimated the cost of completing Poplar Street through quicksand at $572,000 and of constructing a relief sewer along Mill Creek at $79,000, a total of $651,000. He recommended instead a 20-ft. sewer along Mill Creek at an estimated cost of $446,000 ($50 a foot).

The latter plan was adopted and construction started that year at a point between Sixth and Seventh Streets. The engineer's recommendation that the sewer should be 20 ft. wide was adopted and the section was made 15 x 20 ft. It was evidently expected that the sewer would connect with existing culverts but later we find a note that it was decided to remove these culverts in order to secure a more uniform gradient. The section east of Third Street was made slightly larger, but no reduction in size was made as the construction proceeded up the valley, probably because of an appreciation of the rapid increase in the rate of runoff as the valley was built up. It was not until 20 yr. after the beginning of the work and at a point over 3 mi. from the outlet that the size was reduced from 15 x 20 ft. to 15 x 18 ft.



OLD SEWER SYSTEM OF MILL CREEK VALLEY, ST. LOUIS

The sewer was constructed by contract in small sections. The grades on different sections varied greatly, ranging from about one-tenth per cent to over 1 per cent. The total fall per mile for the first 4 mi. is respectively 28, 13, 9 and 9 ft.

EARLY TYPES OF INVERT

Two types of inverts were used. Where the sewer was in rock cut the natural rock was used as the bottom of the sewer. This was quite rough, with steps where the sewer passed from one lamination to another. Where no rock was encountered, the foundation consisted of a course of cottonwood timber 9 in. thick, laid lengthwise under each wall, and on top of this was a transverse course of the same timber 9 in. thick and over 30 ft. long, extending under each wall and forming the floor. It appears that after about 2000 ft. of timber bottom had been constructed a discussion arose as to the adequacy of this timber to carry the load and a recommendation was made that an inverted arch be substituted. This was not done, but the thickness of timber used was increased from 9 in. to 12 in. Of the first 3 mi. constructed, that is from the Mississippi River to Ranken Avenue, about 2600 ft. was built on 9-in. timber, about 11,600 ft. on 12-in. timber and about 1700 ft. on natural rock bottom. For a short distance near the river the grillage rested on piles, but the remainder was founded directly in the clay and in some parts on alluvial deposits. When the last of the 15 x 20-ft. section was being completed the first failure of the timber bottom occurred, and as a direct result all of the remaining construction—that is, the 15 x 18-ft. and 12 x 14-ft. sections, have a cut stone invert resting on a concrete base.

From the river to Compton Avenue the sewer arch is of cut stone 2 ft. thick, haunched with rough coursed stone. From

Compton Avenue to Ranken Avenue it is of common brick, 22 in. thick, also haunched with stone. The stone or brick was laid in a mortar of 1 part cement to 2 parts sand, the cement being Utica for the first two contracts, but from 1876 to about 1885 Louisville cement was used. It is stated that the neat cement on 24 hours test was required to have a tensile strength of 40 lb. per square inch, but actually averaged over 70 lb.

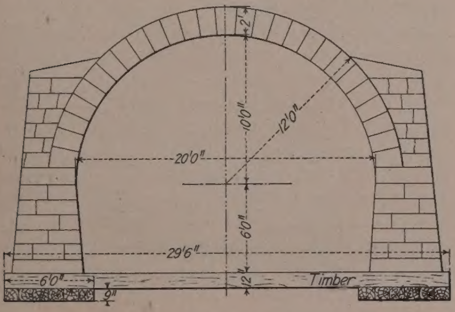
TIMBER BOTTOMS FAIL

The first expense for repairs to the sewer resulted from a failure of the 9-in. timber bottom between Twelfth and Papin Streets. In July, 1880, a settlement of the ground over the sewer occurred, and an examination showed that the timbers in the bottom had broken in the center and that the arch had cracked and settled to such extent that the clear waterway was reduced in height at one point to about 6 ft. This condition occurred in two places, involving a total length of about 485 ft. The fill over the arch at this point was about 20 ft., and the ground under the sewer was a stiff blue clay. Both sections were uncovered and the sewer was reconstructed. The timber bottom of the reconstructed work was set on wooden piles, and 12-in. timber were used for the grillage. In all other respects the reconstructed portion is identical with the original work.

Beyond the ends of the collapsed portion the timber bottom was in bad condition and to prevent further failure the 9-in. timber was cut off at the inside face of the walls, and a cut stone invert 18 in. deep on a 12-in. base of concrete was substituted. This was done for 508 ft. at the time of the reconstruction. Later, in 1885, another section of 717 ft. was built, though the 9-in. timber work was still in good condition. It is reported that the work was done without any disturbance or movement of the sewer arch in spite of the fact that at one point the foundation of a four-story factory building rested directly on the sewer. The remainder of the 9-in. timber bottom was not reconstructed until 1898 and in the meantime the inverts of several sections built on 12-in. timber had been rebuilt of concrete and stone. This work continued intermittently until 1907, when practically all of the timber had been removed. The other principal items for repairs to Mill Creek sewer resulted from two peculiar accidents.

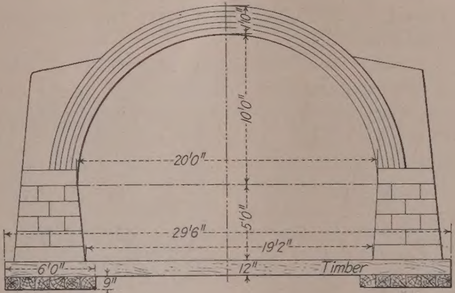
DAMAGE TO ARCH

During a heavy rain-storm in April, 1882, while repairs at Twelfth Street, previously described, were in progress, the temporary timber supports at that place were dislodged and carried to the mouth of the sewer. The outlet section consisted of a double arch with dividing wall. Some of the timbers became wedged at the upper end of the wall, and with other débris completely blocked the sewer. As a result, a section of the arch near Second Street, where the fill was light, was blown out. About 50 ft. of the sewer was broken in this manner. A second storm two weeks later enlarged the break and both rains flooded surrounding property to a depth of from 3 to 5 ft. The whole sewer was submerged at this time on account of high water in the river, and it was necessary to have the obstruction removed by divers at a considerable expense. It was recommended at this time that outlet section be rebuilt as a single arch, but that was not done until six years later.

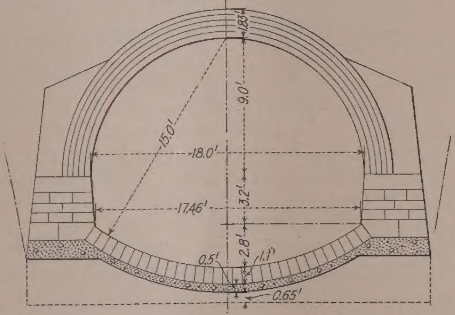


EARLY SECTION WITH TIMBER BOTTOM

The second accident occurred in July, 1892. It was caused by an explosion of gas generated from oil. A few days before the explosion the oil works near Twelfth Street were destroyed by fire. Some of the oil was carried into the sewer and was retained on account of the submergence of the outlet. The explosion blew off the top of the arch between haunches for a distance of about 350 ft. in which the fill was from 3 to 10 ft. and caused damage to masonry for a total length of 1147 ft. A three-story house built over the right of way was wrecked, four persons killed and several injured. The repairs required seven months and cost about $18,000.



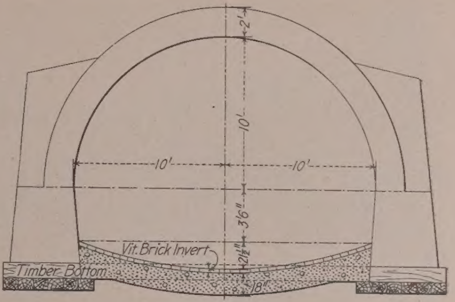
LATER TIMBERED-BOTTOM SECTION



SECTION WITH ORIGINAL STONE INVERT

The only other repair work was in rebuilding broken arches. Two breaks were caused by failure of the timber bottom. At Fourteenth Street timbers were broken and bent upward at an angle of 45 deg. and the sides of the sewer had moved inward, forcing the arch up. At Armstrong Street the arch was depressed. Both breaks were repaired from the surface between heavy wood sheet piling. The arch at Grand Avenue was fractured, probably from internal pressure, and had settled about 1 ft. This arch, which was of brick, was removed from the inside in sections about 4 ft. long and a new arch was built without any appreciable fall of earth into the sewer and with no disturbance of the ground surface.

All of these repairs are listed in Table 2. The total cost of repairs between the river and Vandeventer Avenue has been $358,400, or about one-fourth of the original construction cost for the same portion. Of the amount, $195,600 was expended in replacement of the wooden bottom by a permanent masonry invert and should be classed as betterment rather than repair.



OLD SECTION RECONSTRUCTED WITH CONCRETE AND BRICK INVERT

The following costs per linear foot are of interest:

For 15 x 20-ft. section, stone arch, wooden bottom, constructed between 1860 and 1880.....	$72
For 15 x 20-ft. and 15 x 18-ft. and small length 12 x 14-ft. sections, brick arch, cut stone invert on concrete base, constructed between 1884 and 1887	46
Average cost per foot for 20,383 ft. as per Table No. 1..............................	69
Replacement of inverts in 15 x 20-ft. sections:	
With cut stone invert on concrete base, 1881-1898 av..............................	28
With new concrete invert, 1898-1900 av......	12
With vitrified brick on concrete base, 1903-1907 av..............................	16

The unit prices on the original construction are reported as follows:

Earth excav., $0.22 to $0.94 per cu. yd., av....	$0.53
Earth excav., $0.00 to $2.60 per cu. yd., av....	0.60
Stone masonry, $14.25 to $14.75 per cu. yd., av.	9.10
Concrete, per cu. yd., av....................	5.00
Brick, $4.20 to $11.00 per cu. yd., av.........	6.70
Timber, $18.00 to $32.50 per M ft. BM, av....	24.00
Foundation piling, per linear foot, av........	0.56

NOTE.—Much of the timber in foundation measured 12 x 30 in. and was 32 ft. to 34 ft. long.

The total cost of construction, replacement and repairs for the first 20,383 ft. amounted to $1,763,918, or about $86.50 per linear foot. As will be shown, the cost of providing equal capacity to-day is estimated at about double the above while the cost of displacing the original sewer along the same route would be over three times the original.

PROPOSALS FOR RELIEF

In 1887, the year that the Mill Creek sewer was completed to Vandeventer and Duncan Avenues, the first mention of its insufficiency occurs. The reconstruction of the invert at this time was decreasing the wetted area of the sewer from about 253 to 243 sq. ft., but on account of the additional smoothness of the new work there may possibly have been a slight increase in capacity.

In 1887 Mr. McMath proposed to complete the partially abandoned Poplar Street sewer to Twentieth Street, intercepting the drainage of 925 acres on the north side of the valley. He also proposed to divert the drainage of 1500 acres in the southwestern corner of the district, over the divide, into River des Peres. This 1500 acres, in the Tower Grove district, was at that time not subdivided, so that its run-off was not great, but the Poplar Street sewer was considered an immediate necessity. On account of the difficulties encountered in the early attempts to construct the Poplar

TABLE 1—MILL CREEK SEWER CONSTRUCTION—QUANTITIES AND COSTS

Street location	Size, ft.	Length, ft.	Date of completion	Total cost	Cost per foot
River to Main	15 x 10 double 16 x 20	70 575	April, 1871	$80,621.97	$125.00
Main to Third	15½ x 20	795	June, 1871	77,956.79	98.00
Third to Fifth	15 x 20	520	March, 1870	45,355.22	87.00
Fifth to Sixth	15 x 20	272	June, 1867	32,232.53	118.00
Sixth and Chouteau to Seventh and Carr	15 x 20	1,432	May, 1864	69,647.22	49.00
Seventh to Eighth	15 x 20	952	March, 1866	24,842.54	78.00
Eighth to Tenth	15 x 20		Aug., 1867	49,639.39	
Tenth to Twelfth	15 x 20	1,000	Oct., 1868	95,085.30	95.00
Twelfth to Fourteenth	15 x 20	754	March, 1870	71,735.19	95.00
Fourteenth to Sixteenth	15 x 20	800	Aug., 1871	72,562.59	90.00
Sixteenth to Tayon Ave. (18th St.)	15 x 20	630	Nov., 1872	57,886.82	92.00
Tayon Ave. to Bridge west	15 x 20	970	Nov., 1872	57,340.25	59.00
Bridge to Chouteau Ave	15 x 20	1,332	May, 1873	101,075.25	76.00
Chouteau to Missouri Ave	15 x 20	795	Oct., 1873	62,522.95	79.00
Missouri to Pratt Ave. (Ohio)	15 x 20	1,113	May, 1874	77,021.56	69.00
Pratt to California Ave	15 x 20	841	May, 1875	60,522.54	72.00
California Ave. to Joab	15 x 20	770	Aug., 1875	55,684.77	72.00
Joab to Compton Ave	15 x 20	1,195	March, 1878	59,715.67	50.00
Across Joab (Montrose)	15 x 20	150	April, 1874	10,417.90	69.00
Compton to Ranken Ave	15 x 20	924	Oct., 1879	37,110.13	40.00
Ranken to Theresa Ave	15 x 20	497	Nov., 1884	29,956.80	60.00
Theresa to Prospect Ave	15 x 18	1,406	July, 1885	66,525.32	47.00
Prospect to Cabanne	15 x 18	533	July, 1886	31,576.37	59.00
Cabanne to Duncan Ave	15 x 18	1,296	Dec., 1887	78,433.47	38.00
Cabanne to Duncan Ave	12 x 14	761	Dec., 1887		
		20,383			
Vandeventer Ave. to Sarah	12 (diam.)	1,382	Dec., 1888	26,974.91	....
Duncan Ave. to Alley N. of Pine	10½ (diam.)	1,783	July, 1889	37,013.05	....
Alley to point 330 ft. N. of Lindell	10 (diam.)	637	March, 1890	9,636.34	....
Point N. of Lindell to Whittier	10 (diam.)	990	May, 1891	16,399.90	....
Cost of right-of-way	......	....	....	37,000.00	....
		25,175		$1,532,482.74	
Cost for first 20,383 ft				$1,405,458.54	Av. = $69

Street sewer, and still more because of the important trackage which had been laid on that street, no action was taken under Mr. McMath's recommendation.

In 1891, however, he advised immediate construction of the Tower Grove storm sewer which he said "cannot be safely delayed any longer." The same recommendation appears in each report up to 1895 and work was actually started in 1896. This sewer is 12½ x 15 ft. in section. It diverts the drainage, excepting sewage, of 1500 acres from the Mill Creek sewer into the River des Peres. The total length is 5760 ft. It was completed in 1904 at a cost of $266,150.

While this sewer was still incomplete recommendations were made for additional relief to the Mill Creek sewer. In 1907 the completion of the Poplar Street sewer was again suggested. It was then advised that the relief sewer should extend to Compton Avenue, about 2 mi., instead of to Twentieth Street as at first suggested. This sewer would have diverted the drainage of nearly the whole north side of the valley as far west as Grand Avenue. A rough estimate of cost given at that time was $500,000, which we now know would not have been half enough. This recommendation was repeated in 1902 and the estimate was raised to $600,000. In 1903 the estimate was $750,000.

About this time the attention of the sewer department was diverted from the problem by the need of extraordinary extensions of the main sewerage system in the outlying territory. Fortunately, only one or two heavy storms occurred in the next 9 yr. and the drainage in the Mill Creek valley was not great. In 1912 two excessive rains occurred in 30 days. The new work in extension was nearly all under contract and was approaching completion.

(To be continued)

Dynamiting Fish Breaks Ohio City Water Main

DYNAMITING fish in Buck Creek, Springfield, Ohio, recently cracked one of the sections of the city's water mains located in the middle of the creek, cut one-half of the city out of water for six hours, and cost the city $500 for repair work. It was never learned who did the dynamiting. The photograph on the front cover of this issue shows the men at work pumping water from the hastily constructed coffer-dam, while others are cutting the main and installing an entirely new section.

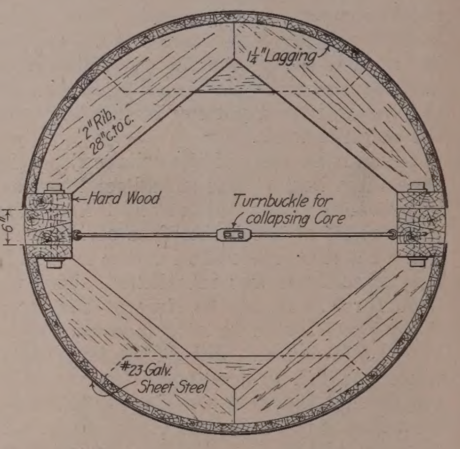
TABLE 2—MILL CREEK SEWER RECONSTRUCTION AND REPAIRS

Street location	Character of work	Length, ft.	Date of completion	Total cost	Cost per ft.
Gratiot, east of Twelfth	Miscellaneous repairs	....	Nov., 1881	$1,799.26	
Gratiot, east of Twelfth	Removing earth from over sewer	....	Oct., 1880	9,096.64	
Gratiot, east of Twelfth	Constructing new bottom	22½	April, 1881	689.52	$31.00
Gratiot, east of Twelfth	Constructing new bottom	156½	Oct., 1881	5,242.75	33.00
Gratiot, east of Twelfth	Reconstructing sewer	262	Aug., 1881	38,226.66	
Sixth and Seventh	Miscellaneous repairs	....	April, 1884	4,128.40	
Sixth and Seventh	Removing earth from over sewer	....	Nov., 1880	3,672.63	
Sixth and Seventh	Miscellaneous repairs	....	Aug., 1881	2,855.69	
Sixth and Seventh	Constructing new bottom	329	Aug., 1882	10,528.00	32.00
Sixth and Seventh	Reconstructing sewer	222	Oct., 1881	30,010.40	
Levee and Sycamore	Reconstructing obstruction at mouth and reconstructing arch.	....	Nov., 1882	2,784.25	
Second and Sycamore		....	Sept., 1882	784.11	
From Tenth westward	Constructing new bottom	717	March, 1885	16,011.15	23.00
At Mississippi River	Reconstructing mouth	82	Jan., 1888	7,916.42	
Levee to 120 ft. west of Broadway	Repairs on account of explosion	1147	March, 1893	17,641.79	
Fourteenth to Seventeenth	Constructing new bottom	1007	Feb., 1898	30,207.00	30.00
Fourteenth to Seventeenth	Removing earth from over sewer	....	Feb., 1897	6,490.05	
Fourteenth to Gratiot	Reconstructing sewer	193	Oct., 1897	28,468.72	
Twelfth to Fourteenth	Constructing new bottom	617	April, 1898	9,257.25	15.00
Sixth and Chouteau to Seventh and Cerre	Constructing new bottom	908	Nov., 1898	9,988.00	11.00
Third to Sixth	Constructing new bottom	855	Jan., 1899	8,279.75	10.00
Twentieth to Armstrong Ave	Constructing new bottom	1683	June, 1899	22,749.66	14.00
Armstrong and Chouteau	Reconstructing arch	62½	June, 1899	2,693.48	
Armstrong to 300 ft. W. of Ohio	Constructing new bottom	1444	Feb., 1900	17,167.53	12.00
Jefferson and Ohio	Reconstructing invert	844	March, 1903	14,970.80	17.00
Josephine westward 1230 ft	Reconstructing invert	1230	March, 1905	18,916.31	15.00
1230 ft. W. of Josephine, W. 1826 ft.	Reconstructing invert	1826	July, 1906	28,295.21	15.00
3056 ft. W. of Josephine, W. 262 ft.	Reconstructing invert	262	April, 1907	3,512.62	13.00
Fourteenth and Gratiot	Restoring pavement	....	May, 1898	1,518.08	
Grand, westward	Repairing arch	188	1901	4,588.02	
				$358,490.15	

Collapsible Core for Reinforced-Concrete Pipe Construction

Detail of Wooden Forms Employed at Aerating Basin Near Ashokan Reservoir of Catskill Aqueduct

THE construction of the aerating basin of the Ashokan reservoir of the Catskill aqueduct, New York City Water Supply, involved a considerable amount of reinforced-concrete pipe under low pressure which is cast in trenches cut in the rock surface. The pipe is cast on concrete cradles and in removable exterior wooden forms, and has cylindrical interior forms or cores, like double arch centers, which are collapsible by the displacement of folding longitudinal pairs of wooden wedges at the springing line. These wedges are secured by bolts in transverse slots allowing them to be very rapidly removed, and the lower pieces are fitted with I-bolts enabling them to be easily withdrawn and handled. The cores are made with diameters of 2 ft. 6 in., 3 ft. 6 in., 4 ft., 4 ft. 4 in., 4 ft. 6 in., 6 ft. and 7 ft. 8 in., and have been found convenient and satisfactory for these sizes



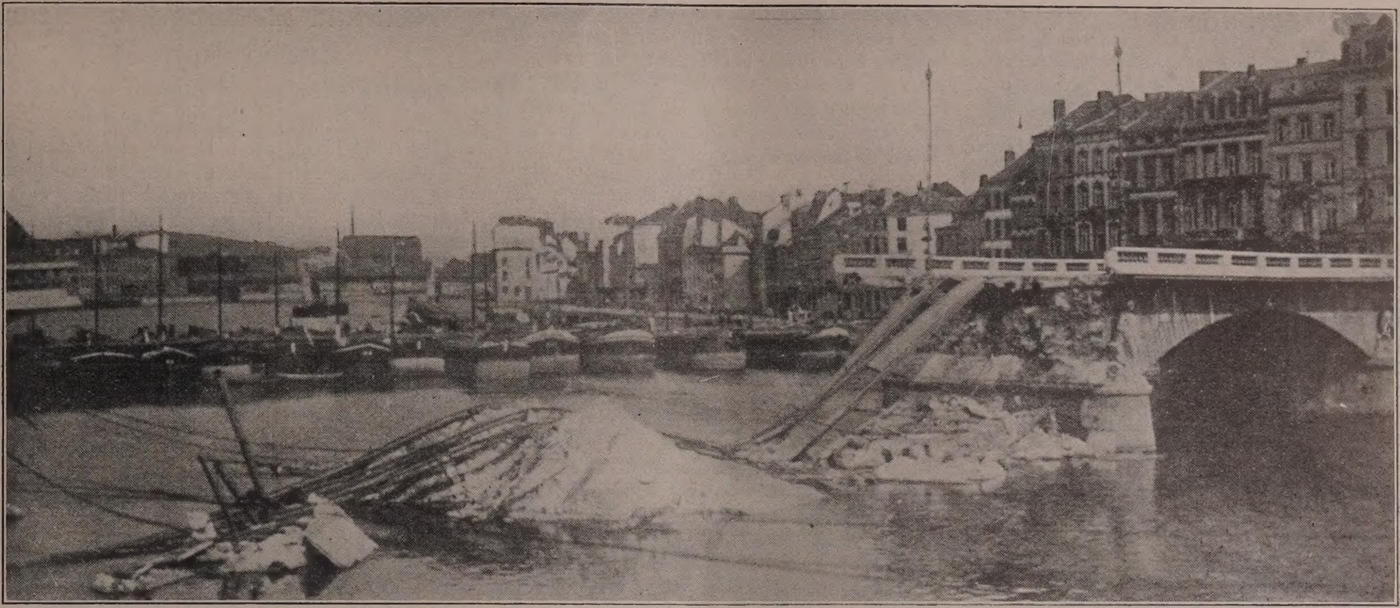
DETAILS OF COLLAPSIBLE CORE

The longitudinal and transverse reinforcement rods are maintained in position by means of rectangular concrete spacing blocks about 3 in. square with wire loops cast into them with the ends projecting. These blocks are attached to the reinforcement rods and their opposite faces set against the forms. They are enclosed by the wet concrete and form a homogeneous part of the pipe. The cores were designed by F. H. Trow, chief engineer for Winston & Company, contractors.

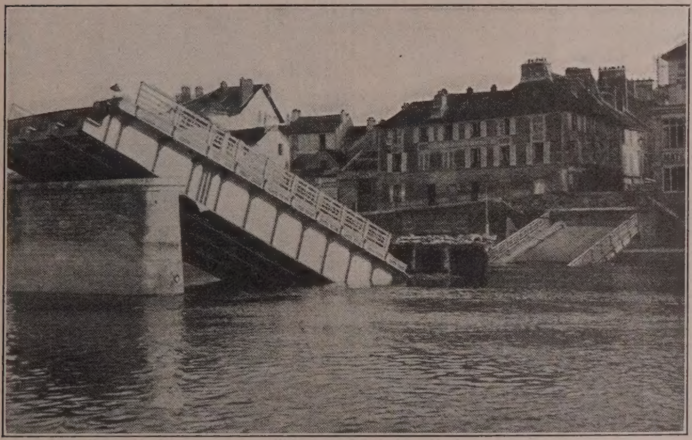
REPAIRS ON THE NATURAL CEMENT FLOORS of the 12,000,000-gal. storage reservoirs at Kansas City during 1913 were made necessary on account of the breaking through from one reservoir to the next under the walls. According to the latest annual report of Burton Lowther, chief engineer of the Water Department, the condition was obviated by driving 10-ft. steel sheet piling as a cut-off wall along the toe of the division wall. A 6-in. concrete floor was then placed over the entire floor and the heads of the piles were sealed over with a heavy slab of concrete made continuous with the floor. All slopes were repaired and cracks grouted. The work was carried on night and day by three shifts of fifty men, each working eight hours.

The Bridge in War Time

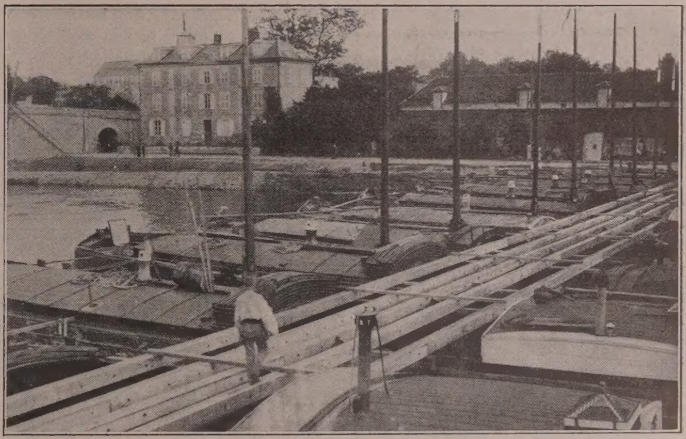
How Rival Armies in Europe Demolish Existing Structures and Build Pontoons on Line of March



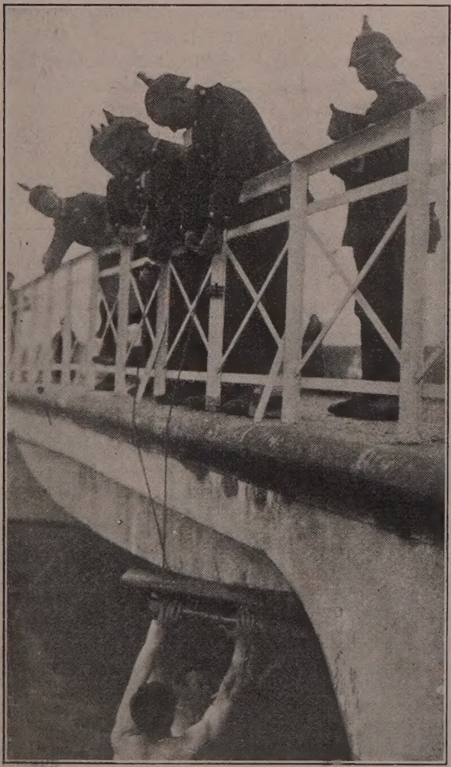
PONT DES ARCHES, ACROSS MEUSE, DESTROYED—IN BACKGROUND GERMAN PONTOON FOR ENTERING LIEGE



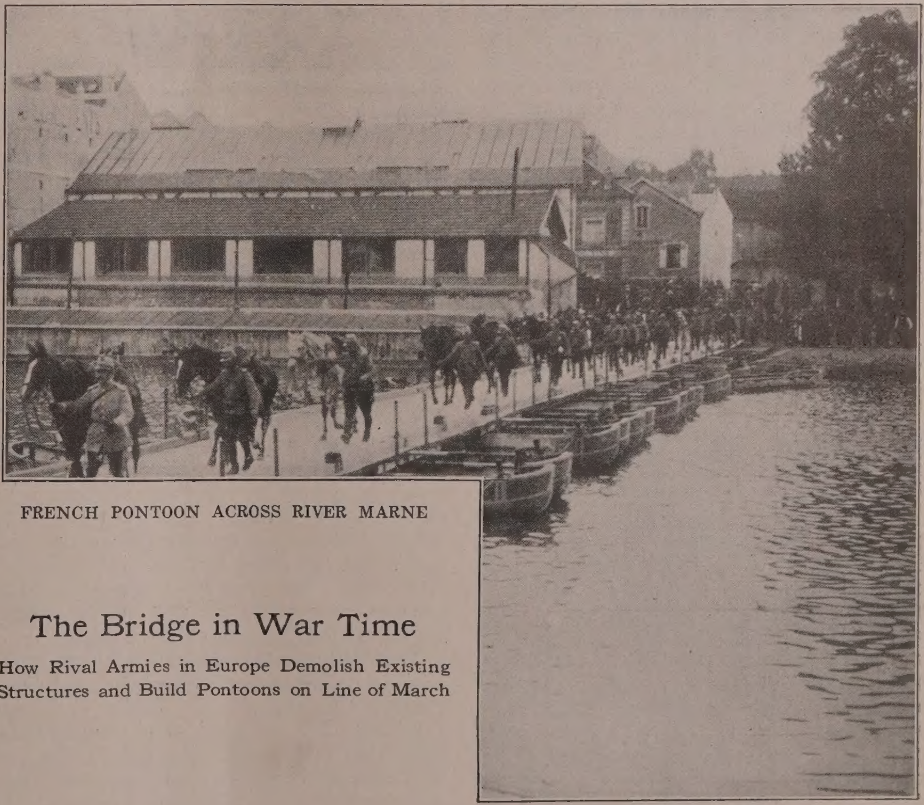
BRIDGE OVER MARNE DESTROYED BY TROOPS



FRENCH PONTOON BRIDGE UNDER CONSTRUCTION



GERMAN ENGINEERS MINING BRIDGE



FRENCH PONTOON ACROSS RIVER MARNE

—Photos Copyright Underwood & Underwood.

Meter Methods in Kansas City

Acid Baths to Remove Corrosion, Results of Testing Large Meters and Meter Readings by Consumers Are Features

BATHING water meters in hydrochloric acid, 2 parts water to 10 of acid, is the method employed in Kansas City to cut off corrosion after the meter has been in service for several years. After the acid treatment, according to the latest annual report of the Water Department, the parts are cleansed in hot water and scrubbed with a stiff brush, leaving the meter in as good condition as when it was new so far as foreign substances are concerned.

Testing large meters, 3 in. and over, increased the revenue $9543 over the previous year by test of 214 meters, 35 of which were found to be losing revenue. A single 4-in. meter was found to register but one-half of the correct amount, bill for which should have been $2368. Owing to this experience one man now devotes his whole time to reading large meters, noting at the same time the conditions under which each is working.

During 1913 practically all outside meters were placed in tile boxes at the curb, costing $6.50, whereas the old brick boxes cost $9. Extension dials, insuring more accuracy of registration, are eliminated. In not one of the 300 tiles in place last winter did a meter freeze.

A total of 30,718 meters were in service at the end of 1913, an increase of 5376 during the year, and 57 per cent of the number of services. The cost per meter to maintain the meter division was diminished from 99 to 52 cents per year. About one-half of the water delivered to the 270,000 consumers passed through meters, the total consumption per capita being 122 gal. daily. Eighty per cent of the revenue came from the metered service.

Consumers read water meters if they are not at home at the time the meter reader calls. A postal card sent out has on it a cut of the meter dial and a request that the tenant mark on the cut the location of the hands on the water meter dial. Nearly 2600 of these cards, practically all correct, were returned in four months after starting the scheme. A booklet on "How to Read Your Meter," distributed to all water takers, contains information on methods of testing meters to determine leaks in the service and has resulted in fewer complaints of high bills as the consumer himself finds the cause and remedies it.

Canadian Pacific Deck Plate Girder Spans

Loads, Stresses and Dimensions of Typical Single-Track Viaduct Deck Spans Measuring in Length 114 and 70 Feet

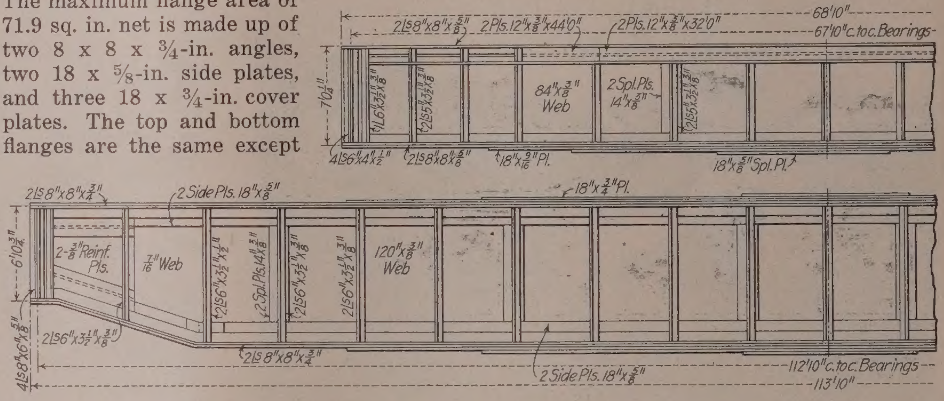
AT the end of the fiscal year, ending June 30, 1913, there were in existence on the Canadian Pacific Railway 4267 bridges and open culverts. These had an aggregate length of 440,237 ft. (85.7 miles). There were 29,704 culverts other than open, of which 16,866 were permanent and 12,838 temporary. During the year 397 old bridges and open culverts were replaced, aggregating 37,063.5 lin. ft.; 1070 culverts, other than open, and overhead bridges were replaced; 195 new bridges aggregating 25,388.3 lin. ft. were added during the year. The number of temporary bridges has been reduced during the year by 165, aggregating 10,088 lin. ft. (1.9 miles), and new turntables have been fabricated, ten 70 ft., one 80 ft., and one 100 ft. in diameter. The accompanying plans show typical features of long single-track deck plate girder spans used in the bridges.

SPAN OF 114 FEET

Bridge 880 over the Trent River is a plate-girder viaduct 1493 ft. long and about 50 ft. high from low water to base of rail. It contains one span of 114 ft. over the deepest part of the channel and the remainder of the structure is chiefly composed of 30 and 45-ft. towers and tower spans connected by 75-ft. spans except in a few cases of spans of from 45 to 69 ft.

The design, conforming to the standard railway specifications for 1908, provides for two 177.5-ton locomotives equal to Cooper's E50. For the span of 113 ft. 10 in. (nominally 114 ft.) this live load produces a total moment of 10,865,800 ft.-lb., requiring a flange area of 70.5 sq. in. The maximum shear of 428,500 lb. is resisted by an 84 x 7/16-in. reinforced web plate at the end and by a 120 x ⅜-in. web plate in the center. The maximum flange area of 71.9 sq. in. net is made up of two 8 x 8 x ¾-in. angles, two 18 x ⅝-in. side plates, and three 18 x ¾-in. cover plates. The top and bottom flanges are the same except that the latter were bent to conform to the reduced depth at the end of the girders corresponding with the depth of the girders in the shorter span. The top and bottom lateral systems are the usual X-bracing of single 6 x 4-in. angles, with connection plates engaging the horizontal legs of the flange angles. The intermediate sway frames are all X-braces of 4 x 4-in. angles.

The 70-ft. girders, actually 69 ft. 10 in. long, have moments of 4,259,300 ft.-lb., requiring a flange area of 41.6 sq. in., and a shear of 279,000 lb., provided for throughout by an 84 x ⅜-in. web, with two shop-riveted splices. The top flange differs from the bottom flange in that it has an H-shape cross-section with a gross area of 51.4 sq. in., and is made up of four angles with their vertical legs reinforced, while the lower flange has a T-shape cross-section with a net area of 42.47 sq. in., made up of a pair of angles having their horizontal instead of their vertical legs reinforced. The lateral systems are the same as in the long spans, but the sway bracing differs in that the upper transverse strut has an I-shape section made with top and bottom flange angles latticed instead of plain angles.



STANDARD GIRDERS WITH H-CHORDS AND LONG SPANS WITH DROP ENDS

The bridges were designed by the engineering department of the Canadian Pacific Railway, of which P. B. Motley is bridge engineer. The viaduct, weighing 785 tons, including 105.2 tons for the 114-ft. span and 40.6 tons for the 69-ft. span, was fabricated and erected by the Hamilton Bridge Works Company, of Hamilton, Ont.

Railroad Earnings for Year Ended June 30

Operating Revenues and Expenses as Compiled by Bureau of Railway Economics

STATISTICS of railroad earnings and expenses for the year ended June 30, as well as those for the month, are presented in Bulletin 65, issued by the Bureau of Railway Economics. Detail figures for 182 railroads are given, comparison being afforded with the year ended June 30, 1913. Of the 182 roads, 106 show decreases in operating revenues, running as high as 12 and 15 per cent. Fifty-one of the seventy-three roads reported in the Eastern district show decreases. Only forty-seven roads in all and fourteen in the Eastern district show decreases in operating expenses. No less than 139 of the total 182 roads and sixty of the seventy-three Eastern roads show decreased net earnings. In percentages these figures are 20 and 30 per cent for a number of the Eastern trunk lines, running above 200 per cent in several instances for the least prosperous lines. The percentages of loss are less for the Western roads, and the Southern lines appear to have fared the best, only fourteen in thirty-six showing diminished net earnings.

The figures are summarized in the following table of revenues and expenses per mile of line:

Account	1914	Increase over 1913 Amount	Increase over 1913 Per cent
Eastern District			
Gross operating revenues....	$22,417	d$960	d4.1
Operating expenses	16,963	305	1.8
Net operating revenues.....	5,454	d1,265	d18.8
Southern District			
Gross operating revenues....	11,093	215	2.0
Operating expenses	8,051	241	3.1
Net operating revenues.....	3,043	d26	d0.8
Western District			
Gross operating revenues....	9,703	d440	d4.3
Operating expenses	6,588	d129	d1.9
Net operating revenues.....	3,114	d310	d9.1
United States			
Gross operating revenues....	13,266	d471	d3.4
Operating expenses	9,557	38	0.4
Net operating revenues.....	3,709	d510	d12.1

d denotes decrease.

The percentage of gross operating revenues consumed by operating expenses for all of the roads increased from 69.1 in 1912 and 69.3 in 1913 to 72.0 in 1914.

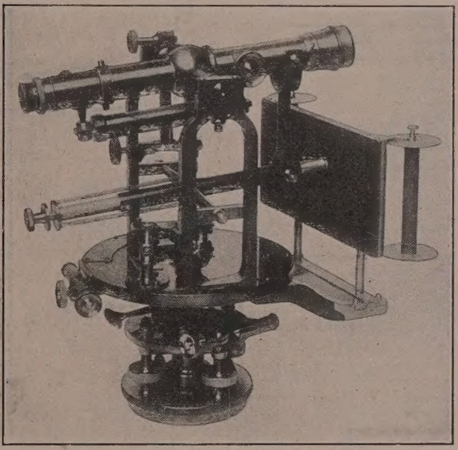
For the month of June the gross operating revenues on all of the roads reported were $1079 per mile as compared with $1135 for June, 1913. Operating expenses were $768 and $801 respectively for June, 1914, and June, 1913. Hence net operating revenues decreased $23, being $311 in June, 1914, and $334 in June, 1913.

Novel Cross-Section Instrument for Valuation Work

Vertical Plane Table Devised to Reproduce the Section in the Field on Reduced Scale Effects Material Saving in Time

BY mounting a needle in a shaft parallel to the line of sight in the telescope of an ordinary transit ,as shown in the accompanying photograph, a miniature of the section may be pricked on the vertical plane-table attachment. The instrumentman, after setting up on the track at a fixed distance away, usually 100 ft., merely sights on the top of a rod held by the rodman at various points in the cross-section to be plotted, thus duplicating the cross-section on a fixed reduced scale.

One of the greatest instrumental tasks of the Division of Valuation, Interstate Commerce Commission, is to determine the amount of cut and fill of the various railroads. One of the parties working out of Kansas City in the Ozark Mountains on the Kansas City Southern has been trying out the new instrument, which was devised by John S. Worley, member of the engineering board.


VERTICAL PLANE-TABLE INSTRUMENT

From a report by C. B. Spencer, engineer in charge of the Road and Track Department of the Kansas City District, a comparison of quantities measured with this instrument with those measured by the engineers of the company, using a wye level on their recross-section, indicate a 1.2-per cent error in a section 20 mi. long and containing 500,000 cu. yd. of material.

Another test was made, comparing progress when using hand level with rod and tape, wye level with rod and tape, and vertical plane table and rod, on 3 mi. of continuous typical road ranging from 1 to 20 ft. in height of fill or depth of cut. The following are the results: With a hand level, a three-man party covered 3 mi. in 34½ man-hours; with a wye level the same party consumed 46¾ man-hours. Plotting cross-sections taken by wye or by hand level with two men required 22¾ man-hours. With the vertical plane table the identical three-man party cross-sectioned the 3 mi. and required 44¾ man-hours. To this is to be added one man's time fifty seconds per section joining points on the cross-section—equivalent to 2¼ man-hours. The saving of the plane-table method over that of the hand level is thus 10¼ man-hours, equivalent to $1.71 per mile if men are paid 50 cents per hour. A corresponding saving of $3.75 per mile was made over the wye-level method.

Measurement of the areas by planimeter required 4 man-hours and checking an equal period; computing and checking by mathematical calculations each took 20½ man-hours. Per mile the planimeter method saved $5.50. To insure comparable data the same employee had charge of all the field work and computations.

At present the party is making from 3 to 3½ mi. per day. Many more shots are taken than would be the case if a wye or hand level were used. In working up the sections the planimeter is passed from point to point along a small celluloid straight edge.

While Mr. Worley has taken out a patent on this instrument, it was done simply to protect the Government, and he has turned it over to the engineering board of the Valuation Division for perfection and future disposal. Only one instrument has been built from stock parts of a Young transit.

Changes in the instrument when it is constructed in any quantity will involve no deviation from the principle, which eliminates all of the ordinary horizontal and vertical errors. Only changes in the design will be made. The needle-point holder consists of a ruby-pointed barrel held lightly by inside springs against the paper, and carries on its inside the needle shaft, which is driven forward into the paper by the outside springs. After using, the needle shaft is drawn back and revolved slightly after a small short pin is clear of its socket. This part of the apparatus will not be altered.

The plane table as designed is not large enough for extremely deep cuts or high fills. It folds down so that it can be worked on, and is mounted on a plate so that it may be set parallel with the section in question on curves. For the present setting 1 in. equals 20 ft. when the instrument is 100 ft. from the section. An extension rig may be devised to make all sections, no matter from what distance taken, an even reduction. The vertical-angle attachment, the level bubble and much of the weight in the frame and level adjusting screws will be eliminated. At present the weight is a serious drawback, the men changing places after an hour's work. The simplest leveling arrangement will be sufficient, as the legs are mounted on little shoes that set on the rails, the instrumentman finding it scarcely necessary to relevel during a half day's work.

Fence Wire Drift Mattresses

Device Employed on River Contraction Works of Middle Mississippi

By F. Y. PARKER
U. S. Assistant Engineer, St. Louis

IN the regulation of rivers various forms of contraction works are frequently used. On the middle Mississippi permeable dikes or hurdles have given good results. Along the upstream side of the hurdles drift constantly accumulates, but the quantity is greatly increased during a rising river and high stages. After a rise of some duration and height drift, varying in size from leaves and small twigs to trees and large logs, is packed against the hurdles in irregular masses, the width, depth and compactness depending upon the juxtaposition of hurdle and channel.

If large quantities of drift accumulate along new hurdles the risk of breaching, from scour and pressure, is greatly increased. To minimize this danger the drift within 30 ft. of the hurdle is sunk. Formerly a brush or lumber mattress was constructed on the drift and weighted with stone until the mass sank. Brush mattresses are still used on heavy compact drift, but fence wire has proved cheaper, easier to handle and more satisfactory in nearly all cases. The standard size, in rolls 320 x 4 5/6 ft., is most suitable.

MATTRESS READY FOR STONE WEIGHTING

After all projections are removed and the drift leveled, unrolling of the wire begins next to the hurdle and, usually, at one end of the drift. Two or three men push the roll of wire forward until unwound, taking care to keep one edge against the piling.

The end of the first roll is wired to the second and the process repeated, with duplications, until a single width of fence wire extends from end to end of the drift. Additional tangential widths are unrolled if the drift will bear the combined weight of the men and the roll of wire. Should the outer drift prove unstable the wire, for its covering, is first unrolled over the preceding width, ropes are attached, and the width pulled into position from flat boats.

After the widths are in position, the tangential edges are bound to longitudinal poles; on these are placed cross poles, ordinarily at 6-ft. intervals, securely wired. Since these poles act as stiffeners to prevent buckling of the mattress when weighted their size and spacing depends upon the character of the drift. The life of the fence wire is 3 to 5 years; this insures the hurdle against scour, during this period, and gives ample time for the submerged drift to become covered with deposit.

UNROLLING WIRE TO BIND MATTRESS

Cost and Efficiency of Rock Drill Mine Work

Three Year Records of Classified Operating Costs for Fifty Machines, and Investigation of Operating Elements

A PAPER on tests of rock drills at the North Star Mine, California, by R. H. Bedford and W. Hague, published in the August bulletin of the American Institute of Mining Engineers, page 1807, gives the average cost of operation of fifty machines with comparative itemized classification for two types of drills, describes a machine used for testing the efficiency of the drills under different conditions of feed and pressure, and gives the conclusions reached from the results of experiments with it. The paper seeks to demonstrate that these data afford a satisfactory basis upon which to judge rock drills.

The rock at this mine is either close grained diabase, or tough granodiorite. The holes are about 4½ ft. deep with an average of 5.65 holes per stope drill shift. The number of drill shifts throughout the mine in 1913 was 18,679 and the cost of labor for drilling, power, supplies, upkeep of machines and air lines, tool sharpening and distribution amounted to 63 per cent of the total mining expense. The drilling was accomplished by fifty-four Waugh stopers and two pluggers, three jack hammers and nineteen water Leyners. The drills were operated at a pressure of about 90 lb., and the cost of repairs is taken from a 3-years' record.

Seventeen No. 8 water Leyner drills were used and these gave an average cost of $6.75 per drill per shift which was composed of the following items: Labor of drilling, $3.25; other labor, 10 cents; supplies, 62 cents; power, 41 cents; engine power, 5 cents; engine oil, 5 cents; 1-in., 5-ply wire-wound hose, 4 cents; ½-in., 5-ply wire-wound hose, 2½ cents; labor, sharpening and repairs, $1.12; labor distribution, 35 cents; steel consumed, 33 cents; air pressure for sharpeners, 15 cents; oil for forge, 21 cents; upkeep of air pipes, 9 cents.

Forty-three 12-A Waugh stoper machines were used with an average cost per shift of $4.83, comprising labor of drilling, $3; maintenance labor, 10 cents; supplies, 37 cents; compressed air, 47 cents; engine oil, 2 cents; ¾-in. 5-ply wire-wound hose, 3 cents; labor, sharpening and repairs, 30 cents; labor distribution, 21 cents; steel consumed, 14 cents; air pressure for sharpening, 4 cents; oil for sharpening, 6 cents; upkeep of air pipe, 9 cents.

Drill Testing

The efficiency of drills from the repair shop was tested by a machine in which the blow of the drill, delivered against a plunger, is measured by the distension of a diaphragm, oil being the medium of transmission. By means of a lever arm the movement of the diaphragm is amplified. A pencil on the end of the lever marking a piece of paper on a revolving drum, gives a graph of the work done by the drill over a given period of time. The graph shows the number of blows per minute and to express the energy of the blow in foot-pounds the tester was calibrated by allowing a sphere of known weight, suspended as a pendulum, to fall through measured distances against the plunger. The distensions of the diaphragm from these blows were noted. By forcing oil into the system with an attached pump the diaphragm was distended to each of these points in turn and the static pressure corresponding to each was read on the gauge. A curve was then constructed with foot-pounds as abscissæ and pounds static pressure as ordinates.

The general method of testing a drill consists in first obtaining graphs in the shop and then the drilling speed under ground. Having passed the first test the drill is used in the mine, a record being kept for several months of the footage drilled. The graphs taken from time to time show whether or not the drill is deteriorating, while the card record of repairs gives the cost of its upkeep. Drills sent to the shop for repairs are not returned to the mine until they show on the tester a satisfactory graph.

The results indicated that drilling speed varies approximately with the blows per minute, the strength of the blow remaining constant. From the results of the tests it was decided that for conditions existing at this mine stoping drills should strike a minimum of 40 ft.-lb. The effect of setting the minimum strength of blow in the stoping drills at 40 ft-lb. has been to increase the breakage of steel by 1 lb. per drill shift and the cost of repairs by 27 cents. The footage drilled, however, has been increased 15 per cent, reducing the cost per foot of whole drill from 20.3 to 18.5 cents.

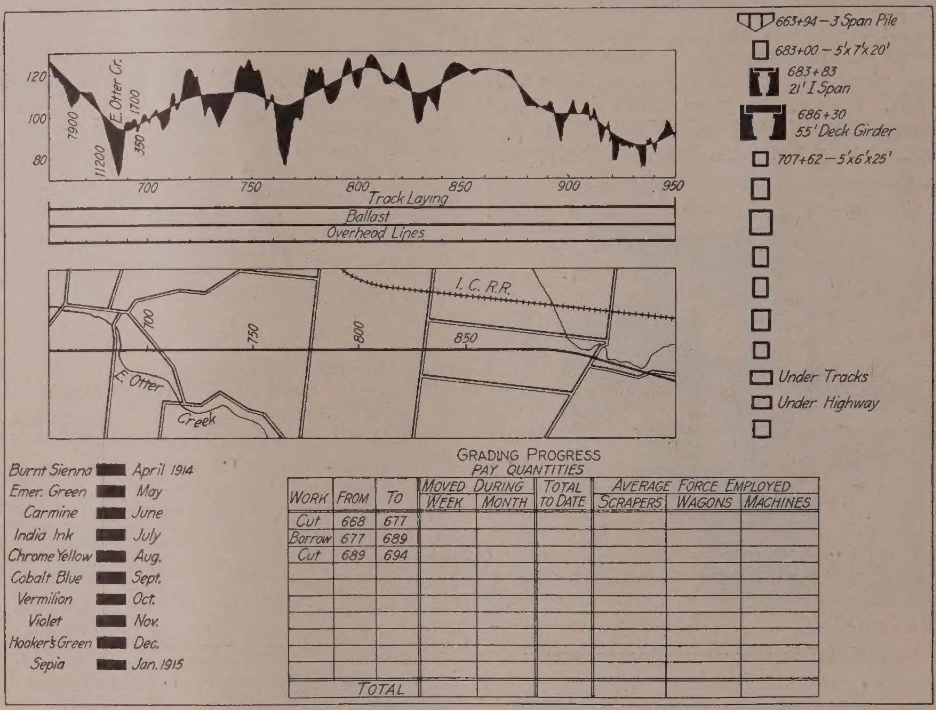
The use of the tester in the shop has greatly facilitated repairs, as any abnormal action in the drill is disclosed at once.

Experiments have demonstrated that if the feed barrel packing is slightly defective the drill does not hold against the ground hard enough, causing as much as 30 per cent decrease in drilling speed. In some cases wear in the barrel bushing after about 250 drill shifts, causes cushioning due to leakage of air, with reduction in the strength of blow as much as 20 per cent. In one type of machine at pressures below 85 per cent the strength of the blow dropped very rapidly.

Comprehensive Progress Report

Correspondence-Size Record of Grading, Concrete Work, Bridge Progress and Track Laying, with Map and Profile

A COMPREHENSIVE progress report sheet has been devised by T. E. Rust, chief engineer of the Waterloo, Cedar Falls & Northern Railway. The sheet is of standard correspondence size and contains means for recording the grading, track laying, ballast, overhead lines, concrete work and bridge progress, together with a map of the line under construction, a profile of the same, and a color chart. The amount of work accomplished, except under the pay quantities for grading, is indicated by the proper monthly color. This sheet is being used in connection with 60 mi. of construction from Waterloo to Cedar Falls, Iowa.



Burnt Sienna	■	April 1914
Emer. Green	■	May
Carmine	■	June
India Ink	■	July
Chrome Yellow	■	Aug.
Cobalt Blue	■	Sept.
Vermilion	■	Oct.
Violet	■	Nov.
Hooker's Green	■	Dec.
Sepia	■	Jan. 1915

GRADING PROGRESS
PAY QUANTITIES

WORK	FROM	TO	MOVED DURING		TOTAL TO DATE	AVERAGE FORCE EMPLOYED		
			WEEK	MONTH		SCRAPERS	WAGONS	MACHINES
Cut	668	677						
Borrow	677	689						
Cut	689	694						
TOTAL								

FORM FOR REPORTING PROGRESS IN DETAIL IN RAILROAD CONSTRUCTION

In the lower right-hand corner is the title, "Progress Report," a blank for filling in the week or month it is effective, and the following notes:

"Report is to be sent to chief engineer on Monday of each week and as soon after the first of each month as practicable. On the profile, etc., color all work to date of report. Monthly reports are to be made from monthly estimate data.

"By 'average force employed' is meant the total number of scraper or wagon days divided by the number of days embraced in the report. For example, if seven scrapers worked on a cut one day during a week, the average force on that cut was one scraper for that week. If a dragpan, grading machine, etc., worked on a cut or borrow, state kind of machine and number of days it was operated."

Rapid Concrete Work in the St. Louis waterworks tunnel, described in the Engineering Record of Sept. 19, 1914, page 322, was done with equipment furnished by the Concrete Mixing & Placing Company, of Chicago. By mistake the name was given as the Concrete Machinery & Placing Company.

How to Use the Technical Journal

Paper (Slightly Condensed) by John W. Alvord, Consulting Engineer, of Chicago, Presented at the Convention of the Federation of Trade Press Associations, Chicago, September 24-26

In 1880, when the writer first commenced to take some interest in technical journals, such publications in this country were relatively few. We had the Engineering News (1874), the Sanitary Engineer and Building Record (1880) (now the Engineering Record), Van Nostrand's Magazine (now defunct), the American Engineer and Railway Journal (1832), the Railway and Engineering Review (1864), Railway Age Gazette (1856), the Engineering and Mining Journal (1866), the Electrical World (1874), and a number of trade papers of some interest to engineers. Only the railway journals were really financially able to cover the ground in their respective fields. All were far less comprehensive than at present. In 1880, the engineer treasured and indexed almost every scrap of printed matter on any engineering subject that came his way. To-day his task is to sort out, discard, and eliminate that which he can no longer use, and limit himself to the inspection and reading of that which bears principally on his selected professional specialty.

That we cannot keep abreast of the times without reading the engineering journals is obvious. That if we carefully read all the engineering journals in our chosen specialty we would have no time left to earn a living is easily capable of demonstration. What then is the proper attitude to adopt toward this ever-increasing flood of information that pours in upon us so relentlessly?

SUBSCRIBERS' ATTITUDE TOWARD PAPER

If we look about us to see how our fellow engineers solve this matter we shall find a great variety of attitude toward the problem. Some engineers simply do not take engineering journals; reading one occasionally here and there as opportunity offers. Others take all they can afford to take and let them pile up around the office, often unopened and unused. Others still limit themselves to a select few, which they carefully bind and shelve. Still others read journals when they can, and throw them away when they move on. As a rule, however, the engineer prizes his technical paper, and endeavors in some ill-defined and formless sort of fashion to preserve its information for future use. Generally he fails to find any practicable scheme which makes his rapidly accumulating material of much value to him after it has once passed under his eye, and for a large number of engineers, technical journals are only professional newspapers with which to idle away an hour or so and satisfy their curiosity. That their value is something much more than this, or should be more than this, is so apparent as to need no denial.

The problem of the engineer with his technical paper is much affected by his age, station and aim in life. To the man who is engineering only to get money and more money, the engineering journal is a newspaper, in which he may notice mainly where there are better jobs than his own that may be sought after and perhaps obtained. To the man who is anxious to fit himself every year of his life for something better it is an opportunity, quite unequaled many years ago, for a great variety of study. To the young engineer the engineering journal, properly read and noted, is a part of a post-graduate course in engineering. To the middle-aged man it is a mine of data, bearing in all sorts of ways on his work; and to the mature specialist only does it begin to become burdensome by its repetition of experience, and its volume of matter on subject which has already, to him at least, been well digested. Let us see if we can outline how each of these classes can get more profit out of the matter contained in the engineering journals than do the careless or the indifferent, who, after their journal is once looked over, let it go to waste or idleness.

PROBLEM OF YOUNG ENGINEER

The young engineer and the college graduate need, most of all, practical experience. It is safe to say that engineering literature will never have any proper perspective for him until he has been connected in some capacity with engineering work himself, be it in ever so modest a capacity. With the actual doing of engineering work, however, should come contemporaneously the reading of technical journals, particularly along the lines in which he is working. Nothing can be more instructive, broadening, and enlightening to a man doing a particular kind of work than reading about similar work at the same time. It follows, therefore, that the young engineer should as early as possible, take at least one first-class engineering journal and own it himself; bind it if he can afford to, but lay it away in an orderly manner, in any event. If he can afford two journals so much the better, especially if they are selected so as to widen his outlook.

It is to be doubted if laborious reading of all kinds of engineering articles all the time is advisable for anyone. Mere quantity of reading is mentally detrimental. If one might advise, it would be to suggest enforced systematic reading of all articles particularly bearing on the line of work the reader is immediately engaged upon, and the optional reading only of such other articles as interest him. This ought not to be much of a task. In course of time as his experience broadens, engineering reading will become less burdensome and more interesting because its relation to practical matters will be more and more appreciated, and the discriminating use of engineering literature better understood. Of course, all this applies to engineering societies as well; but that is another story.

CARD INDEX CAUTION

It is probably not wise for the young engineer to indulge extensively in card indexes, filing systems, and the like, for topically arranging his available engineering journal articles. Few men know very early in life where fate and interest will land their future attention, and filing systems and special indexes are expensive and time consuming, and when indulged in without definite aim nearly always quickly become too voluminous and thereby useless. If any suggestions are made along this line, it would be to start a loose leaf, letter-size (8½ x 11-in. page) notebook and note in it (separate pages for separate subjects) only what appears to be extremely useful, either in exceedingly brief abstracts from engineering articles, or diagrams, costs, etc.

The young engineer is tempted to read much about large enterprises—the Panama Canal, big bridges, astonishing tunnels, great dams. This does no harm, and probably holds his interest for the time being. Gradually he learns that, for him at least, the chief value of the technical journal does not lie in its dramatic side, necessary as that may be for our general information, interest and pleasure, but its chief value lies in a fund of small things, which make up routine work of the ordinary every-day job. These are to be watched for, and noted, as practically useful to the average man.

THE MIDDLE-AGED READER

We next come to the man in early middle life, actively engaged in his profession, and note at once that his problem with the technical journal is the absence of "time." Absorbed in a multitude of responsibilities, harassed with unexpected difficulties, worn out at night with the long day of strain, how shall he derive any useful good from the multitude of journals which his more ample income can readily afford, but which pile high on his table after every brief absence from the office? Whether or not such an engineer shall make any effort to systematically assimilate, file, and study current technical journals depends in part upon the nature of his routine. If he is largely engaged in administrative work, or is a salaried officer in a large enterprise with a comparatively limited range of problem or a limited call for miscellaneous data, he may generally be content with a cursory examination of the engineering journal such as will keep him qualified on his undertaking, and the preservation of such journals in bound form, with the standard published indexes. If, however, he is entering upon novel work, or work presenting a great variety of problems, overlapping into a great variety of fields, ambition will compel him to do more than this, and some form of special indexing will appeal to him more or less strongly as he feels the need more often for research in up-to-date material.

The average editor can judge of a technical article with only a brief inspection—a sentence here and there, a headline, and a moment's reading of the summary and conclusion. Long familiarity with matter of a similar character gives him the assurance that he can detect in this rapid review anything novel, new, or original, and can fairly pass judgment upon it in a general way. The working engineer who has had some experience with technical literature can form the same habit, and save much time. It is really wonderful how much repetition there is in engineering writing and in the production of engineering papers. It thus happens that we are under the necessity of seeing much the same facts and principles repeatedly published in varying form, for some one is always attracted to really read them, with consequent benefit to himself, under the belief that they are new and novel.

The mature engineer notes that a large amount of engineering literature is of the purely descriptive order, merely giving outline of work that has been accomplished, without going into reasons or principles. All this kind of writing is valuable and useful, and has its proper place, but all of this class of literature has its limitations. One of the most severe of its limitations is that it rarely describes mistakes, errors of judgment, or failures, and in these lie the most valuable lessons to the seeker after truth. One is obliged to read between the lines or read with reservation, much as one does in reading accounts of battles in the daily press. It is always wise to look back and note the origin of the despatches in such cases.

A tremendous lot of engineering literature is written which is of little permanent value. Often it represents the writer's struggles to understand a subject. Often it is compiled largely from a desire for publicity. Fortunately the editors of the technical papers can limit this kind of reading by care in selection.

Separating Wheat from Chaff

But amid all these drawbacks a discriminating mind will always find a great deal of wheat amid the chaff, and the wheat that will be gleaned will be of differing kind and amount, depending upon the type of mind of the reader, his present problem, and his desire to systematize his information. What, therefore, shall he do with his special selection when once he thinks he has separated it from the flood of raw material?

Several courses are open to him:

First, he may rely on his memory and the published index to his bound volumes. It is safe to say, however, that few engineers really make much practical use of this method. The intervening index and the bother of a search prove to be discouraging to that degree that a proposed reference search is abandoned in about one-half the suggested attempts. The ideal filing system is one in which, with the least amount of effort, one can put his hand immediately and accurately on the thing itself, be it a book, a pamphlet, or a data sheet.

Second, he may keep a special card index of important data and reference to valuable articles. This at once involves labor and attention which few busy men can give and which, if done by assistants or librarians, largely loses its personal value to the one who needs it. The same objection as to the discouraging effect of intervening indexes holds good here, too, and it is further safe to say that of all the contrivances for indexing the most difficult to handle readily and examine rapidly is the card index system.

Third, he may abstract important data in a limited way on loose leaf transparent paper, standard letter-size, and he may remove or detach articles of special value from out his journals, to be filed in regular office file system, like correspondence.

The writer has tried all of the above methods at considerable cost in time and patience, and has, for many years, settled upon the third method. With all its admitted limitations it seems to be the best for an office which is expected to find out information on a great variety of subjects in a limited time, and with the least amount of effort.

Data for Reference

Some description of its practical workings may be of interest:

All the technical papers of the office pass on to the desk of the head of the office and are at least looked over (not read) by him. Articles important to his particular specialty are checked with pencil, and articles of especial interest are looked over with care and double checked. Once in a long while data important enough to go to the data file are noted. This is either especially abstracted by the stenographer, or, if a diagram or cost data, perhaps traced in the drafting room, all on transparent paper for copying purposes. Special data of this kind, on 8½ x 11-in. sheets, are filed in the office data file (a separate but common standard correspondence file). From the data file loose-leaf working notebooks are made up from blueprints for office or travel purposes. They are altered, refilled, amended and sorted back from time to time as needed to keep them of usable volume and usefully up-to-date.

The technical journals, with checked articles, go to the office clerk or the stenographer at odd hours, or the librarian if one can be afforded, and the useful articles are removed by tearing them out with a ruler. They are folded, usually once, to standard size, with one edge lap left for binding, and are then filed in a subject index file, like current correspondence. The Dewey Decimal system, especially arranged for the office, is used, but only as a general subject plan. When the file is full, portions of its contents, especially that which is most useful, are simply bound in plain pasteboard covers and placed in the library shelves, with titles. Such a book (or many books) would contain all the recent articles thought to be of special value on a given single subject. The remaining portions of the technical paper are thrown away, but in a large office, warranting the expense, duplicate bound copies can be kept as well, with the general published index as their key.

Objections and Advantages

The objections to this system are as follows:

First, it is too expensive for any but the most important offices doing specialized work. Second, data accumulate almost too fast unless rigidly kept down to a minimum. Third, it requires some personal attention of the head of the office, a competent assistant, or the employment of a regular librarian.

The advantages are:

First, it compels the office head to know all the time what is being published in current engineering literature, if only by inspection. Second, it removes all intervening indexes between the searcher and the final repository in bound volume. Third, it keeps one's library usefully up-to-date on all lines in which one should be especially interested. Fourth, it is economical of final shelf room and cost.

Obviously, one should not start so elaborate a system as this unless he is fairly sure of the special line of engineering to which his life will be devoted. Otherwise, waste effort and discouragement will be certain. It is not to be recommended to the young man, but only to the mature man of early middle life when his work clearly indicates the necessity for it. It is, however, the prime requisite of the engineering specialist. To him some such a system is invaluable. Not a few consulting engineers use this standardized system interchangeably, particularly the data file, thereby greatly increasing its usefulness to one another as a joint effort.

We come finally to the mature and experienced engineer of advancing years. How can he make engineering and technical literature of use? It is safe to say that when an engineer has much passed fifty or sixty years of age and has led an active life, his need for engineering literature lessens. Out of the mass of detail which seemed to him so overwhelming and endless in his youth and early manhood, fundamental principles emerge like peaks out of the clouds, and upon these as foundation all detail classifies itself simply and naturally, and therefore, he fells less need for accumulated data or particular description. Probably no one enjoys engineering reading as does the mature engineer, for he can read between the lines and find much to instruct as well as interest, and yet while he is probably the most interested and intelligent reader of engineering literature that the journals have, his ambition as a collector is gone and filing systems no longer appeal to him.

If his acquaintance is wide, he reads with interest the accomplishments of his friends, and the addresses of society presidents and articles on the ethics of the profession. Of failures he is the keen student. The personal column appeals to him, and if he is of right-mindedness he is conscious of more pleasure than formerly in the accomplishments of those who have succeeded and succeeded well in dire and burdensome responsibility. More often than the young man he will turn back for his satisfaction to papers that served him well in times past, and perhaps smile at the lack of improvement that later attempts to deal with their subject often show.

Technical papers, along with the technical societies and their proceedings, form the repository of the professions; they are the interchange of experience, the common store upon which we all draw. Without them we would be strangely helpless. We are indebted to every one more or less who records his experience for the common use, and that debt we should endeavor to helpfully repay in kind, but wisely, concisely and thoughtfully.

Cable Twister on Concrete Job

FORM faces on the track elevation work of the Chicago, Milwaukee & St. Paul Railway north of Wilson Avenue, in Chicago, described on page 240 in the Engineering Record of Aug. 29, are held together by cables made of eight strands of No. 10 wire prepared with a butterfly nut on each end in a special cable twister operated by two men. The butterfly nuts are threaded to receive short bolts passing through the forms. These nuts are made by the thousand in the shops of the railroad company. Occasionally six-strand cables break, but with eight strands no forms have given trouble. The cables are spaced on 3-ft. 4-in. centers vertically and on 4-ft. centers horizontally. Six 25-ft. cables are used to hold the bulkheads against the ends of the side form faces. The twister is composed of two 6 x 6-in. braced timber uprights, one of which is fixed and the other movable, mounted on a timber base, and fitted with a hand-operated crank.

A Chicago City Car Tracer, mounted on a motor cycle, keeps track of cars in transit loaded with material for the Bureau of Streets. He covers a distance of 25 mi. per day, and through him the bureau is enabled to facilitate the quick delivery of material for its municipal asphalt plants and other repair operations.

Decay in Wooden Bleachers

Condition of Stands at University of Wisconsin and Discussion of Treatment Methods and Costs of Preventing Deterioration

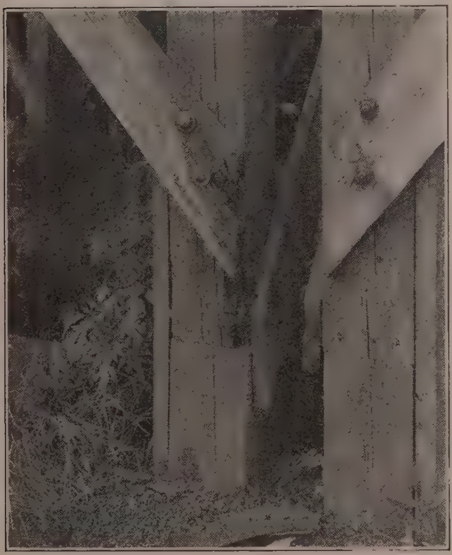
By C. H. TEESDALE

In Charge of Wood Preservation, Forest Products Laboratory, Madison, Wisconsin

THE north bleachers on the university athletic field, Madison, Wis., were torn down this summer because of decay. This stand seated over 5000 people. It was built eleven years ago, of Norway pine, at a cost of $4,500. It is not surprising that no attempt was made to protect the stand from decay by some preservative treatment when one considers that the greatest progress along that line has been made since these bleachers were erected. However, the case offers an excellent opportunity for a criticism of the practice of exposing untreated timber to attack by decay.

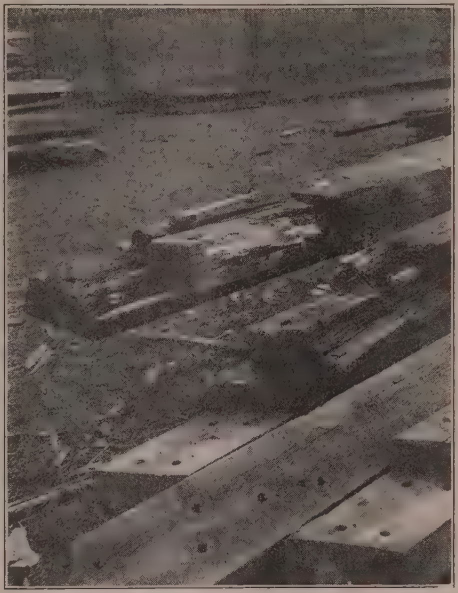
JOINTS WEAKENED

A close examination was made while the bleachers were being wrecked and many members were found unfit to support their load, although the decay was generally confined to the joints. Rain water would run down the braces and collect at the joints where enough would be retained to keep the parts moist, making conditions very favorable to decay, as shown in the photographs. The braces seen in these photographs could carry very little loading.



TIMBER IN DANGEROUS CONDITION

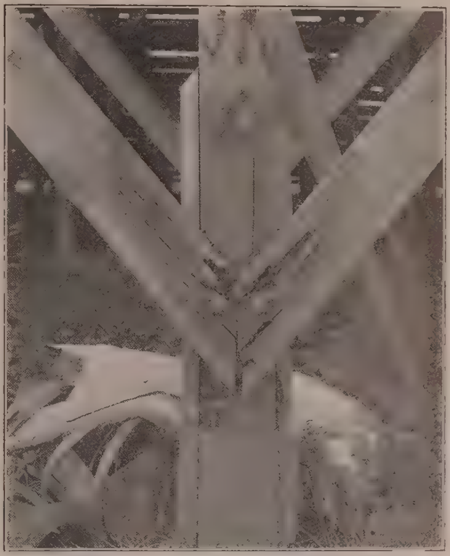
The ground line is usually the point of most severe attack and about two years ago the ends of the upright columns had to be renewed, which was done by splicing with new material. Although the newer pieces were still in good condition the old columns had again become badly damaged where they were spliced. No doubt infection had extended up the column farther than was evident at the time the ends were removed and destruction continued rapidly, probably aided by the moisture collecting in the joints. Obviously the splicing should be done very carefully so as to remove all the infected material—which is difficult to determine—and in such a way the joint would not collect moisture. It is far better to avoid the necessity for such splicing by properly treating the timber at the start.



DECAY IN COLUMN ENDS

The upper ends of the columns were also decayed in the joints. It is evident that no part of the stand was free from attack because of the distance from the ground, provided sufficient moisture was present. The seats also had decayed.

The need for a preservative treatment is evident. A good treatment is a matter of economy in practically every instance where wood is set subject to decay, and particularly so where decay which is confined to only a portion of a structure necessitates entire rebuilding, as in the case of this stand. The bleachers would have been in much better condition and would have given longer service if the joints and parts in contact with the ground had been given a thorough brush treatment with hot coal-tar creosote having a specific gravity of about 1.03 to 1.08 at 60 deg. C. A still better method would have been to treat all the lumber with about 0.5 lb. of zinc chloride per cubic foot and then give the ends and joints a subsequent brush treatment with creosote.



DECAYED JOINT AT COLUMN SUPPORT

It is estimated that each end of the braces and supporting columns in this structure could have been painted with or dipped in creosote for less than $200. It is also estimated that all portions of the stand with the exception of the seats could have been given a treatment with zinc chloride for about $500, and the ends of those members in contact with the ground, or those trimmed or cut after treatment, could have been brush-treated with creosote for an additional $100, or a total cost of $600 for this treatment. The seats could have been built of a durable wood, for instance heart cypress or redwood, at an additional cost of about $300.

Assuming an interest charge of 5 per

GENERAL VIEW OF SEATS SHOWING DECAYED BOARDS

WISCONSIN GRANDSTAND PARTIALLY WRECKED

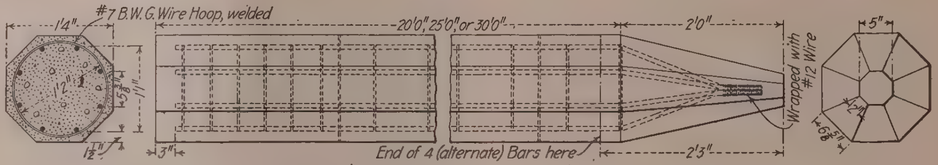
cent per annum, a first cost of $4,500, and a life of eleven years, the annual charge against the untreated structure would be about $540.

If given a brush treatment with creosote at an additional cost of $200, the structure would have to last only 11.5 years to give the same annual charge.

If given a treatment with zinc chloride and creosote and using a durable wood for seats as suggested above, with a total increase in cost of $900, the structure would have to last about 14½ years to give an annual charge of $540.

It is estimated that in the first case suggested the structure would last at least 14 years, and in the second case at least 20 years, reducing the annual charges to about $475 and $430 respectively, a saving of 12 per cent of the final cost on one and 20 per cent on the other.

PILE CASTING YARD WITH PILES IN VARIOUS STAGES OF COMPLETION



MAIN DIMENSIONS AND REINFORCEMENT DETAILS OF STANDARD PILE

Illinois Central Concrete Pile Trestle Work

Nearly 2 Miles of Concrete Trestles Built by Railroad in 36 Miles of Double Tracking between Fulton and Memphis

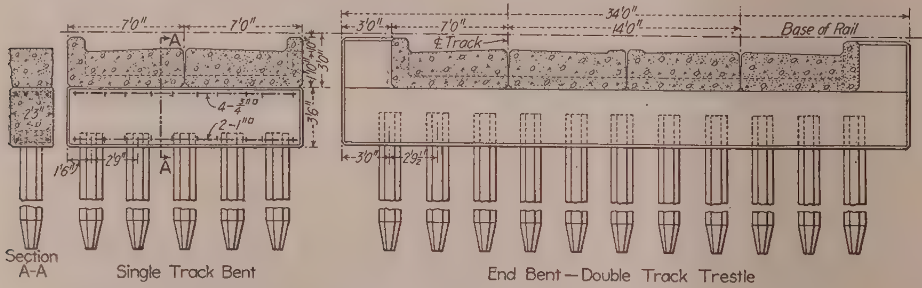
NEARLY 2 mi. of concrete pile trestles are included in the 36 mi. of double-tracking which the Illinois Central Railroad is now bringing to completion on its Tennessee division between Fulton and Memphis. About 4000 octagonally shaped concrete piles, 16 in. in diameter and varying in length from 20 to 40 ft., were made for the work, according to Illinois Central standard specifications. The piles were made of a 1:2:4 mix and reinforced by longitudinal corrugated bars held in place by wire rings. A shipment was made when the piles were twenty days old. The minimum age for driving was thirty days after being poured.

The piles were driven by company forces, using a derrick-car pile driver operating from the track. All piles were driven by a 3¼-ton Worthington steam hammer, a wood and steel cushion block weighing about 2600 lb. being set on top of the pile to be driven to prevent the pile from getting a direct hammer blow. Wooden test piles were driven at every third bent at the various bridges to give an idea of the length of pile needed. As the panel points are 14 ft. apart, this meant that test piles were driven every 42 ft.

About 1350 concrete slabs, 16 ft. long, 2 ft. thick and 7 ft. wide, with copings at the sides 10 in. high and 12 in. wide, were used. Most of the slabs were made at the Illinois Central slab yard at Fulton. They were moved three weeks after being cast and were placed in the work two months after being made. The slabs rest on caps 14 ft. long, 2 ft. 3 in. wide and 3 ft. 6 in. thick. A 1:2:4 mix was used for both slabs and caps. The slabs were waterproofed with two coats of pitch and 12 in. of ballast were placed directly thereon.

On long bridges having ten or more panels a double or anchor bent containing eight piles was constructed at every sixth bent. At every anchor bent and monolithic with the cap a concrete partition wall was used to prevent the slabs on a long bridge from having any horizontal movement beyond a length of five panels. A 2-in. expansion joint between slabs was allowed for at each anchor bent.

The work includes about thirty-six concrete trestles varying in length from 16 to 1648 ft., and bridges over the North Fork Deer, South Fork Deer and Obion rivers, consisting of through-plate girders on concrete piers, with concrete pile approaches. The bridge work, which is now completed except for a small amount of steel and slab work on the larger bridges, was carried out under the direction of F. G. Walter, assistant engineer, reporting to Maro Johnson, engineer of bridges. The concrete piles and 250 of the slabs were furnished by the C. F. Massey Company, of Chicago and Memphis.



TYPICAL SINGLE-TRACK BENT AND END BENT FOR DOUBLE-TRACK TRESTLE

ERECTION VIEW OF TRESTLE, SHOWING BLOCKING ON PILES ALREADY DRIVEN

PANAMA TOLLS during July amounted to $4,688.40 collected at Balboa and $2,970 at Cristobal, a total of $7,658.40, states the "Canal Record."

Why Not Hold to Standard Widths of Railway Roadbed?

While Maintenance Men Are Asking for More Ballast They Should Not Be Losing What They Have from Too Narrow Subgrades

By J. T. BOWSER
Maintenance-of-Way Department, Queen and Crescent Route, Danville, Ky.

THANKS to the various associations of railroad engineers and track men, it may be said, broadly speaking, that all American railroads have adopted a standard cross-section of roadbed which meets more or less successfully the conditions encountered along their various lines. But in how many cases is this standard adhered to, even approximately? Considering the matter only in connection with ballasting, the economy to be effected by adherence to a proper standard cross-section of roadbed makes the matter well worth the attention of men interested in track work.

A properly designed standard for cross-section of roadbed in cuts provides, in the subgrade, a shoulder of sufficient width to leave a substantial margin between the ballast line and the edge of the track ditch, and gives this shoulder a slope that insures drainage away from the ballast. The standard ditch, varying in cross-section with the character of the country, should readily care for all water draining into it, so that the ballast is kept clean longer and drains more promptly.

Where the standard is not maintained, in earth cuts more particularly, the track ditch becomes filled with washings, and unless cleared and restored will very shortly drain all water and cut washings from the slopes into the ballast, necessitating forking or cleaning otherwise, if not new ballast, not to mention the greater expense of maintaining the track before the ballast is cleaned.

Even in cuts that are well drained and where ditches are kept open a great deal of ballast is lost if the standard as to the width of the shoulder beyond the ballast line is not adhered to. With too narrow a subgrade shoulder in such a cut the loss of ballast into the ditch is considerable, as that which gets into the ditch is either washed out or taken out when the cut is ditched. Ditches, as a rule, become blocked readily enough without wasting good ballast to fill them.

As is the case with cuts, the proper standard for cross-section of fills provides a width of subgrade sufficient to insure a good margin between the ballast line and the edge of the slope. On fills where this width is not maintained the waste in ballast down the slope is readily seen, but the full extent of this waste is not generally appreciated.

The first and probably the greatest loss of ballast on a narrow fill occurs when unloading and handling the ballast, particularly when regular ballast cars which dump only in the center of the track are used. This loss, of ballast, however, does not end with the unloading and dressing up of the ballast, but continues with the vibration of every train which passes over the track and with every footstep of trespasser or employee on the ballast shoulder. A derailed car which only marks the ties slightly will cause a great deal of loss in the ballast dislodged.

Nor is the loss of ballast all the increased expense that is involved, for the loss of ballast from the shoulder cannot fail to loosen that tamped under the ends of the ties, and the results are low places, kinks, loss or increase of elevation on curves and center-bound track.

Good ballast and more of it is probably the need of every track man, but why not expend some of the ballast appropriation to provide a roadbed on which ballast can be retained in good condition? The yearly loss of ballast due to narrow subgrade will pay for the construction of considerable standard roadbed.

Stream-Diversion Project in Northwest

Agreement between King and Pierce Counties, Washington, to Spend $1,500,000 Directing White River Permanently toward Tacoma

INTER-COUNTY strife, bred of disagreement whether White River should discharge into Puget Sound at Tacoma or at Seattle, 32 miles to the north, was terminated by action taken at the last meeting of the Washington State Legislature, and plans are now being prepared for a joint improvement, comprising the erection of a concrete diversion dam 1620 ft. long and the clearing, straightening and reinforcing of the channel, routing the stream permanently Tacoma-ward. Description of these unusual developments has been furnished by W. J. Roberts, chief engineer of the improvement.

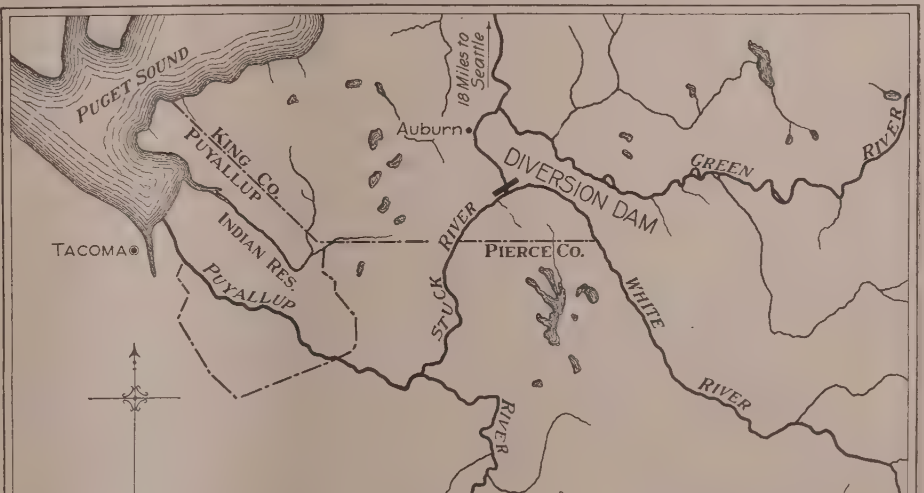
Between Seattle, in King County, and Tacoma, near the border in Pierce County, runs a strip of high land shutting off a rich valley from the Sound. To the east the ascent to the Cascade Range forms a steep watershed, the runoff from which, especially when the melting of snows occurs simultaneously with heavy rains in the lowlands, has at times caused widespread damage. Near Auburn, just inside the King County line, but nearer Tacoma than Seattle, White River has built an inland delta where its steep course is interrupted by the valley, its bed having reached an elevation of 140 ft. The grades by either route around the impeding ridge of land are nearly the same and the river has vacillated in its choice, accumulations of drift throwing the flood first via Duwamish River toward Seattle, more often into the other route, half as long, via Puyallup River to Tacoma. King County, which had an advantage in that the river reached the valley within its confines, spent money to prevent it from flowing toward its county seat. Feeling that this action unfairly added to its flood-protection problems, Pierce County brought suit. Bitter feeling among the farmers affected and their town neighbors resulted in armed guards and nearly caused bloodshed.

LEGISLATIVE RELIEF

At the last meeting of the State Legislature (1913) this unfortunate condition was recognized and a law passed permitting two or more counties to contract together on improvements for their joint benefit. King and Pierce Counties were quick to take advantage of this new legislation and agreed upon an expenditure of $250,000 per year for a period of six years for solution and relief from this trying problem, the main feature of the arrangement being that the White River should henceforth and forever take the shorter route, i.e., via Puyallup valley and Tacoma harbor to Puget Sound.

These unusual conditions are shown on the accompanying map of the region. Green River will not be affected by the diversion but will continue to flow toward Seattle by way of Duwamish River.

The dam which the Inter-County River Improvement purposes to build will replace a temporary dike which has influenced the river toward Tacoma for seven years. Its dimensions will be as follows: Top width, 4 ft. 6 in.; base width, 10 ft. 7 in.; height, 14 ft., and length, 1620 ft. Construction will involve 18,100 cu. yd. of excavation, driving 25,920 lin. ft. of piles and placing 5841 cu. yd. of concrete.



LOCATION OF DAM FOR DIRECTING WHITE RIVER TOWARDS TACOMA

How to Insure Minimum Cost and Prompt Delivery of Steel Reinforcing Bars

Reasons Why Odd Sizes, Short Lengths, Special Specifications and Changes in Orders Are Uneconomical—Part II

By A. D. MELLOR
Contracting Engineer, Concrete Steel Company, New York

EVEN if the question of time of shipment was unimportant (this is a Utopian ideal in which the bar merchant likes to indulge his fancy, but which he never hopes to see realized because, invariably, the customer wants his steel delivered "yesterday") there would be a good and sufficient reason for not ordering any more sizes than was absolutely necessary. For with an order calling for many sizes of odd dimensions there will be constant confusion and delay from the time the bars leave the mill until they are in place in the work, due to the difficulty which an ordinary workman has in distinguishing bars varying by odd sixteenths. Any one who has been out on the work and had to handle average workmen will appreciate the difficulties of a task which he himself could not accomplish without the aid of calipers and rule. To the workman a difference of a sixteenth is a trivial matter, but from the designer's point of view five, or seven, bars 1/16 too small make the strength of a beam or girder quite different from what it would be if the right sizes were used. Table 4 gives the percentage of error that would result from choosing a wrong size.

SHAPE AND LENGTHS

Sometimes an order for a single piece of work calls for both round and square bars. From what has already been said about the influence which variety in sizes has on the time of shipment, it will be clear that the addition of another shape can only increase the probability of delay in rolling.

When the mill man is asked for word as to the probable time of shipment, he searches the schedule for the following information:

1. How many shapes?
2. How many sizes?
3. How many lengths?
4. What is the tonnage in each case?

The fewer the number of shapes, sizes and lengths and the greater the tonnage in each case, the shorter will be the time required for shipment. We have already explained the reason for this in the case of the first two items. In regard to the matter of lengths, it should be understood that when there is a considerable run of uniform lengths the gage on the rolls is set and the bars are cut as they come from the final pass. If there are only a few pieces of each length, it is necessary to take the bars to a cutting machine where they are cold sheared to the specified lengths. This takes extra time and makes the order less desirable.

TABLE 4—EFFECT OF ERROR IN USING BAR 1/16 INCH TOO SMALL

Diameter, In.	Area rounds, Sq. In.	Stress value at 20,000	Difference	Per cent decrease in strength
¼	0.167	3,340		
			1,880	36.1
5/16	0.261	5,220		
			2,280	30.4
⅜	0.375	7,500		
			2,720	26.6
7/16	0.511	10,220		
			3,120	23.4
½	0.667	13,340		
			3,560	21.1
9/16	0.845	16,900		
			3,960	19.0
⅝	1.043	20,860		
			4,380	17.3
11/16	1.262	25,240		
			4,800	16.0
¾	1.502	30,040		

LACK OF UNIFORMITY

Again we find the practical field work on the job complicated by lack of uniformity. To check a shipment of bars is a task difficult enough without any unnecessary complications, as will be witnessed by anyone who has ever done such work. Unfortunately the checking of the bars when they are unloaded is not the last time that the different lengths have to be identified. The problem of identification is met every time a bar is needed. Of course, if the job is a large one, a man can be placed in charge of the stock and care can be exercised to arrange the various lengths in piles so as to enable the stock-keeper to locate any desired length readily. But this increases the cost of the work unnecessarily and such favorable conditions for overcoming the difficulties under discussion are not usual.

Many different lengths of large sizes make the work of bundling difficult and discourage the mills from performing this valuable service. Bars ⅝ in. and smaller are usually bundled, which simplifies the work of identification on the job.

Bars should be scheduled without fractions of an inch. It is difficult to shear with an error of less than an inch without special care. When bars are to be placed between steel I-beams, a note should be made to that effect on the order, giving the maximum allowable variation. Special care will then be taken so as to prevent difficulty in placing the bars.

Lengths less than 5 ft. should be avoided, if possible, as they are subject to the following cutting extras, whether sheared or hot sawed:

For lengths over 24 in., 5 cents per 100 lb.

For lengths 12 to 24 in. inclusive, 10 cents per 100 lb.

For lengths under 12 in., 15 cents per 100 lb.

QUALITY

Previous to 1910 there was no standard specification for quality of steel for reinforcing purposes. Almost every buyer had his own ideas as to what the composition of the bars should be and insisted on his orders being rolled in strict accordance with his individual specifications. As a result the mills found their capacity very much cut down because of the large number of different billets which they were obliged to handle. The manufacturers bore this burden for a while, but the rapid increase in the use of reinforced concrete soon made the conditions at the mills so complicated as to force the Association of American Steel Manufacturers to seek some method of simplifying their problem. An examination of the various specifications which were coming to them showed that the differences were not important. From suggestions received from important engineering organizations and individuals in response to a circular letter on the subject, the differences of opinion were harmonized and the result was the following standard specifications, which are practically the same as those of the American Society for Testing Materials for billet steel bars:

1. *Manufacture.*—Steel may be made by either the open-hearth or Bessemer process. Bars shall be rolled from billets.

2. *Chemical and Physical Properties.*—The chemical and physical properties shall conform to the following limits.

Properties Considered	Structural Steel Grade		*Hard Grade		Cold Twisted Bars
	Plain Bars	Deformed Bars	Plain Bars	Deformed Bars	
Phosphorus, maximum:					
Bessemer	0.10	0.10	0.10	0.10	0.10
Open-hearth	0.06	0.06	0.06.	0.06	0.06
Ultimate tensile strength, pounds per square inch	55/70,000	55/70,000	80,000 min.	80,000 min.	Recorded only
Yield point, minimum, pounds per square inch	33,000	33,000	50,000	50,000	55,000
Elongation, per cent in 8 in., minimum	$\frac{1{,}400{,}000}{\text{T.S.}}$	$\frac{1{,}250{,}000}{\text{T.S.}}$	$\frac{1{,}200{,}000}{\text{T.S.}}$	$\frac{1{,}000{,}000}{\text{T.S.}}$	5 per cent
Cold bend without fracture:					
Bars under ¾ in. in diameter or thickness	180 deg. †$d = t$	180 deg. $d = t$	180 deg. $d = 3t$	180 deg. $d = 4t$	180 deg. $d = 2t$
Bars ¾ in. in diameter or thickness and over	180 deg. $d = t$	180 deg. $d = 2t$	90 deg. $d = 3t$	90 deg. $d = 4t$	180.deg. $d = 3t$

*The hard grade will be used only when specified.
†d = diameter of bar; t = thickness.

3. *Chemical Determinations.*—In order to determine if the material conforms to the chemical limitations prescribed in paragraph 2 herein, analysis shall be made by the manufacturer from a test ingot taken at the time of the pouring of each melt or blow of steel, and a correct copy of such analysis shall be furnished to the engineer or his inspector.

4. *Yield Point.*—For the purpose of these specifications, the yield point shall be determined by careful observation of the drop of the beam of the testing machine, or by other equally accurate method.

5. *Form of Specimens.*—(a) Tensile and bending test specimens may be cut from the bars as rolled, but tensile and bending test specimens of deformed bars may be planed or turned for a length at least 9 in. if deemed necessary by the manufacturer in order to obtain uniform cross-section.

(b) Tensile and bending test specimens of cold-twisted bars shall be cut from the bars after twisting, and shall be tested in full size without further treatment, unless otherwise specified as in (c), in which case the conditions thereon stipulated are to govern.

(c) If it is desired that the testing and acceptance for cold-twisted bars be made upon the hot rolled bars before being twisted, the hot rolled bars shall meet the requirements of the structural steel grade for plain bars shown in this specification.

6. *Number of Tests.*—At least one tensile

and one bending test shall be made from each melt of open-hearth steel rolled, and from each blow or lot of 10 tons of Bessemer steel rolled. In case bars differing ⅜ in. and more in diameter or thickness are rolled from one melt or blow, a test shall be made from the thickest and thinnest material rolled. Should either of these test specimens develop flaws, or should the tensile test specimen break outside of the middle third of its gaged length, it may be discarded and another test specimen substituted therefor. In case a tensile test specimen does not meet the specifications, an additional test may be made.

(d) The bending test may be made by pressure or by light blows.

7. *Modifications in Elongation for Thin and Thick Material.*—For bars less than 7/16 in. and more than ¾ in. nominal diameter or thickness, the following modifications shall be made in the requirements for elongation.

(e) For each increase of ⅛ in. in diameter or thickness above ¾ in. a deduction of 1 shall be made from the specified percentage of elongation.

(f) For each decrease of 1/16 in. in diameter or thickness below 7/16 in. a deduction of 1 shall be made from the specified percentage of elongation.

(g) The above modifications in elongation shall not apply in cold-twisted bars.

8. *Number of Twists.*—Cold-twisted bars shall be twisted cold with one complete twist in a length equal to not more than twelve times the thickness of the bar.

9. *Finish.*—Material must be free from injurious seams, flaws or cracks, and have a workmanlike finish.

10. *Variation in Weight.*—Bars for reinforcement are subject to rejection if the actual weight of any lot varies more than 5 per cent over or under the theoretical weight of that lot.

A large percentage of concrete reinforcement is now rolled in accordance with these specifications, which means that all orders calling for these grades of steel are put through in the shortest possible time. If some other quality, not so common, is called for it may be held up pending the scheduling of other orders calling for the same grade in order to make a rolling. If the specification has peculiarities all its own, it will have to be handled separately, meaning special work and unusual delay in rolling.

The specifying of an odd quality of steel for a large undertaking usually leads to annoying complications, especially in cases where the contract was awarded under public letting. If a contractor on one of the sections requires a small amount of reinforcement to start his work without delay, or if he has ordered and placed all his steel and finds that for an unforeseen reason he needs a small additional amount, he may discover that it is difficult, if not impossible, to find a stock of the particular quality called for in the specifications. If the mills are busy, he may find it impossible to get them to accept such a small order for rolling. The red tape of getting around this obstacle will cause a great deal of delay. which would be avoided if this standard had been used. Large quantities of this quality of steel are in stock in various parts of the country.

Making Changes in an Order

In a case where a shipment is urgently needed, it is not advisable to attempt to make changes in the schedule after it has been booked by the mill. A rolling mill is a very complicated piece of mechanism, difficult to wield. As soon as a mill receives notice of a change in a schedule, word is sent around to all the departments, from the metallurgical department to the rolls, ordering work on the entire order suspended. To try to change a schedule gives the mill a good excuse for slow handling.

It is the general practice of experienced reinforced concrete contractors to add about 2 per cent in long lengths to their calculated requirements for a job, so as to cover contingencies.

Lump-Sum vs. Hundred-Pound Basis of Buying

Some contractors believe that buying steel reinforcement on the lump-sum basis is cheaper than on the hundred-pound basis. The fact that the big contractor buys on the hundred-pound basis is an indication that the lump-sum basis is not the best one. An explanation of how a lump-sum figure is made up shows the fallacy of the lump-sum idea.

When a lump-sum bid on steel reinforcing bars is made up, the schedule of the necessary pieces is extended at the theoretical weights for the various sizes. The total weights for the several sizes are then extended at the base price with the various extras for size, quantity and length, as required by the schedule. The total of these pieces for the various sizes is then increased by from 2½ to 5 per cent on account of possible over-rolling in weight. In this connection, it should be explained that due to human frailty it is impossible for the mills to roll the bars to the exact theoretical weight as given in the tables for round and square bars. The rolls may be set further apart, or nearer together than would be required for the theoretically correct sizes. All contracts at the mill are taken subject to plus or minus rolling variations. Some contracts call for a 2½ and some for a 5 per cent possible over-rolling in weight, with a possible maximum under-rolling of minus 5 per cent. As it is entirely a matter of chance whether the rolls will be set so as to roll plus or minus, the steel company cannot afford to figure on the theoretical weight and take the risk of losing 2½ or 5 per cent, which would be the case if the steel over-rolled the maximum amount. It will readily be seen that if the lump sum accepted by the buyer is based on the theoretical weight plus the allowable over-rolling and the bars happen to be rolled to the maximum under-rolling limit of 5 per cent, he has paid for from 7½ to 10 per cent more steel than has been shipped to him. In other words, from the buyer's point of view, buying on the lump-sum basis is a game at which he cannot win but may lose. If he buys the steel at a price per hundred pounds, no more steel can be shipped to him than is required by his schedule, and he has an opportunity of getting the required steel at a lower total figure if the rolls happen to be set so as to under-roll.

There is a further advantage of buying on the hundred-pound basis, in that any number of changes may be made in the schedule without raising the question of price. If a buyer has bought on the lump-sum basis and wishes to reduce his schedule, the complicating factor of size-extras makes it impossible for him to prove what deduction should be made by the seller for the weights of the sizes cut off the schedule.

For the above reasons, it is clear that a perfectly definite contract for steel on the hundred-pound basis can be entered into for the requirements of a reinforced-concrete structure of any sort before the designing work has been started.

Preparing Macadam Roads for Asphalt Topping in Chicago

Method Involving Use of Portable Asphalt Plant —Field Force Required—Cost and Quantity of Work

METHODS of preparing old macadam roads for a 2-in. asphalt topping in Chicago differ somewhat in different localities. Where the existing surface is in good condition and has a suitable line, grade and contour, the surface is swept thoroughly to remove all the loose particles and expose the rough stone. If any depressions exist they are filled with binder and tamped. In this way the existing road is made parallel to and 2 in. below the finished surface. Along the edges of the road care is taken to provide a good shoulder to hold the pavement in place. Where the soil is soft, stone is added and the shoulder thoroughly rolled.

Where the old macadam is flat or depressed at the center the sides are picked

UNLOADING A CAR OF STONE PER HOUR FOR CHICAGO ROADS

LAYING MACADAM BASE

up and the material moved to the center. Care is taken not to lower the sides so that less than 4 in. of stone exist in a firm condition. If additional material is required the street is scarified to a depth of 3 in., and material added, making the center at least 10 in. in depth and the sides 6 in. About 2½ in. is found sufficient for drainage from the crown to the edge.

Percentage of Mix

The percentage of mix for the topping will average 6.5, bitumen; 37.2, torpedo sand; 52.3, stone, and 4, filler. The aggregate is Universal Portland cement, torpedo sand and crushed granite, ranging from ¼ to 1 in. in diameter and costing $2.25 per cubic yard. The portable asphalt plant, described on page 195 of the Engineering Record of Aug. 15, is located on a central track with a switch track 16 ft. away on either side, so that materials can be unloaded in front of the different conveyors. This plant, according to information received from Walter L. Leininger, superintendent of the Bureau of Streets, is completing a mile of road each week at a cost of 70 cents per square yard. At the plant the force consists of a foreman, chief drum man, kettle man, mixer man, 2 timekeepers and material men, 25 laborers, 18 teams, 1 assistant chemist and 2 watchmen. The field force comprises 1 asphalt foreman, 2 rakers, 2 smoothers, 2 tampers, 15 helpers, 2 watchmen and 2 roller engineers. These men produce and lay 2500 sq. yd. of 2-in. top per day. In order to hold the present macadam streets in place until they can be resurfaced at some future time the Bureau has used this year 1,720,000 gal. of heavy road oil, costing approximately 3.64 cents per gallon.

ADVANCE-PRODUCTION CURVES, which are in fact estimated-progress curves plotted in advance of the work done, have been used by the Aberthaw Construction Company, of Boston. Their use, it is said, has made it possible to spread the whole work out more evenly, thereby keeping the force fairly constant for long periods, making the workman feel that his job is reasonably secure during the continuance of the construction work, and eliminating the disorder that results from the sudden influx of untrained men when part of the work must be rushed.

American Wharf Design

Distinctive Features of the Principal Types Used in the Various Ports, and Discussion of Their Comparative Advantages and Costs

WHARF design varies greatly in different parts of the United States. The extremes are perhaps the all-timber type that prevail in New York City and the all-concrete design used in San Francisco. Between these types are numerous combinations of timber and concrete, and each is admitted to have its special adaptability. A résumé of the principal types with discussion of their comparative advantages and costs, was presented at the recent convention of the American Society of Port Authorities, by W. J. Barney, consulting engineer, of New York City. These notes are taken from his paper.

A most insistent problem lies in the selection of a proper type of wharf construction, proper not only for the port as a whole, but also for the particular commerce to be handled. No precise formula serves to solve this problem for given conditions. Policy frequently affects the selection of materials for construction and thus frequently the design or type. Finances form another of the factors in the selection of port types.

The majority of our important ports have developed under the pier and slip plan. Provided the fairway or harbor is not too narrowed for ready navigation by the projecting piers, this system has the decided attraction over quays of providing far more wharfage per linear foot of shore front. Desire to secure this greater wharfage has resulted in such narrow piers (50 to 75 ft.) and narrow slips as to cause costly congestion in the handling of merchandise and in the moving of modern vessels. Later designs, unhampered by property restrictions call for piers ranging from 120 to 300 ft. in width and slips varying from 200 to 300 ft. in width.

The open wharf is usually of the pier type, although occasionally its structural features are found in wharves lying along banks which for economy have not been confined by retaining walls.

New York Type

The New York type of open pier is composed of a wooden or concrete floor system resting on a substructure of wooden piles arranged in bents, the piles running up to the under side of the pier deck. The incline bents consist of a single row of piles on 5-ft. centers, and are spaced 10 ft. apart. The four out-shore bents are each composed of two rows of piles on 2½-ft. centers and are spaced about 23 ft. apart. The fender system consists of oak fender piles driven at the end of each pile bent with fender capping and chocks to hold the piles in place. Perhaps the most distinctive feature has been the development of the concrete deck with asphalt wearing surface to replace the wooden deck and wearing surface ordinarily used elsewhere.

Cost figures were given by Charles W. Staniford, chief engineer of the Department of Docks and Ferries, in a paper presented to the American Society of Civil Engineers in 1913. The cost of the open pier, assuming the general dimensions to be the same, varies with the lengths of piles. For usual pile lengths it ranges for the single-bent portion of the pier from $1.23 to $1.60 per square foot and for the double-bent portion of the pier from $2.46 to $3.05 per square foot. These figures are for a pier with a wooden deck and wearing surface and do not include the cost of any artificial bottom or pile kagging. In the latter about $18 a pile may be added, and $2.50 should also be added for each foot of fendering system. Mr. Staniford gives costs of 87 and 97 cents per square foot respectively with and without asphalt wearing surface. Because of the great sizes of the piers to which he refers the prices may be regarded as low for piers of usual dimensions, say from 60 to 100 ft. wide, and from 500 to 800 ft. long.

The New York open pier is admirably adapted to the natural conditions. Sewage pollution of the waters in the North and East Rivers and the upper Bay, practically permanent, has driven out wood borers, so that the pile substructures are permanent below mean tide. The tidal range averages about 5 ft. Therefore, as shown by severe fires, there is practically no fire risk in the pile substructures between mean water and the pier deck. Over the pier sites the water varies from 15 to 40 ft. in depth, generally too deep for an economical design of solid wharf or filled-in pier.

Philadelphia Construction

As at New York, Philadelphia wharves are usually open piers. Philadelphia, however, has sought to develop a type of pier that will be permanent from mean water up, yet having the cheapness of a wooden-pile subaqueous substructure. Transverse bents of two rows of piles are cut off approximately at 1½ ft. above low water. The bents are spaced 20 ft. center to center, longitudinally of the pier. The piles are clamped and capped, and this framing is covered with a light timber deck upon which are set concrete walls approximately 11 ft. high, these walls being in reality continuations of the pile bents to the pier deck. These cross walls support a system of steel floorbeams overlaid by a concrete deck or a system of reinforced-concrete floorbeams and slabs. On the concrete deck is laid pavement as a wearing surface.

Certain distinctive detail may be noted. The wearing surface of the deck is composed of 4-in. wooden-block pavement. The fendering system does not consist of the usual fender piles, but of fenders bolted directly into the ends of the concrete cross walls and the sides of the floor system. A peculiar feature of this pier is a substructure under the unshedded portion of the outer end of the pier. Extra piles are driven between the two outer bents, and the floor system on which the cross walls rest is extended over these piles so as to floor over entirely the open space between the bents. The cross walls on these outer bents are designed as retaining walls with returns along each side of the pier, thus entirely enclosing the floored-over area. The pocket thus made is filled with earth to the level of the pier deck, on which is laid a concrete slab with wearing surface, this making a very substantial outer end to the pier.

Recently the port authorities requested bids on several modifications of the above design, and also on a design after the New York type, these designs calling for a pier 550 ft. long by 180 ft. wide. Bids ranged from $2.15 to $2.54 per square foot for the New York type, and from $2.23 to $3.07 per square foot for the more permanent designs. (See Engineering Record of June 6, page 638.)

SAN FRANCISCO—ALL CONCRETE

The natural conditions at San Francisco are best met by the construction of the open pier all in concrete, substructure and superstructure. With a tidal range of only 4 ft. 3 in., the deep water close in shore to the established bulkhead line over the pier sites requires the open or pile type of substructure; and, on the other hand, with firm foundation reached from 40 to 75 ft. below sea level there is little apprehension of settlement so detrimental to concrete structures. The bay is so infested with the teredo that the life of the ordinary wooden pile is only from 6 to 12 months. Hence at San Francisco has been evolved a distinctive type of concrete pier. The characteristic feature is the use in some form of large reinforced-concrete cylinders or columns in place of the comparatively small reinforced-concrete pile used in the Baltimore wharf. These cylinders are from 3½ to 4 ft. in diameter, and with reinforcement permit of such concentration of the floor load that they are usually spaced on about 20-ft. centers in both directions. The floor systems were first steel I-beams for stringers and decking, then steel framing encased in concrete with a reinforced concrete slab. For heavy traffic, vitrified brick has been used as a wearing surface.

For cost data, it may be noted that the successful bidder for piers 30 and 32 in 1912 cited the following prices: For cylinders 3 ft. 10 in. in diameter, $3.15 per linear foot; cylinders 3 ft. 6 in. in diameter, $4.93 per linear foot; cylinders 4 ft. in diameter, $4.58 per linear foot. The Fort Mason piers are believed to have cost about $3.35 per square foot.

PORTLAND CONSTRUCTION

Another interesting design of "open wharf" was prepared for the Portland (Oregon) Commission of Public Docks, but has not been followed as yet. The supports of this type of wharf are wooden piles driven in clusters cut off at low water, capped by a wooden and concrete grillage and surmounted by concrete columns or pedestals from low water to the deck level, these supports being centered on 10-ft. squares. This type was designed to meet extreme variations in water levels, where at seasons of low water some 30 ft. of the substructure might be exposed for several months in an extremely dry climate. The fire risk is thus obviated by the concrete columns from low water. On the other hand, the cheapness of subaqueous timber constructions was secured by founding these columns on timber, piles being permanent here, since the teredo is absent.

SOLID WHARVES

In the solid wharf a retaining wall is built on the perimeter of the pier. The area within the retaining walls is then filled by dredging from the adjacent fairway or by fill dumped from the mainland. A usual type of retaining wall is designed as follows: A platform on piles, timber or concrete is constructed, the deck of which is near the level of low water. On this platform is built a retaining wall, sometimes a timber crib, frequently of concrete and masonry. The top of this retaining wall is at the level of the pier deck. The platform is wider than the bottom of the retaining wall, the extra width being to the rear of the wall and acting as a relieving platform. At the rear of the relieving platform sheet piling is driven with a sufficient penetration into the natural bottom. In this way a continuous retaining wall is formed to inclose the pier area, which is then filled in. This type of retaining wall is generally termed as a "relieving platform wall." Its cost varies with the design from $80 to $125 per linear foot.

There are many modifications of this platform type of construction. In some cases the retaining wall is founded on piles, steadied by a riprap filling in the front, extending from the natural bottom to the under side of the retaining wall. Since this riprap continues the retaining wall to the natural bottom, sheet piling is unnecessary. Frequently in front of this type of wall a platform on piles is constructed at wharf level. This platform stiffens the wall and provides sufficient depth of water in front thereof for the wharfing of vessels. The cost of this wall is generally higher than the relieving type, running from $150 to $250 per linear foot, depending upon the amount of riprap filling.

Frequently where suitable bottom is reached at a reasonable depth a solid retaining wall is constructed, founded on the bottom and running up to the wharf level.

At Baltimore has been designed a unique type of retaining wall for a solid pier with moderate depth of water alongside. Steel cylinders, afterward filled with concrete, were driven around the outline of the pier, and spaced 25 ft. center to center. Between these cylinders continuous sheet piling was driven—the lower end with sufficient penetration to hold at the bottom, the upper ends retained by longitudinal steel and concrete girders running horizontally from cylinder to cylinder, on which they rested. These girders were held back against the sheet piling by tie rods, anchored in reinforced-concrete piles inside the prism of thrust.

GENERAL SUMMARY

Summing up, experience limits the construction of open wharves to widths not greater than 150 ft., usually from 60 to 100 ft. Beyond this width it soon becomes more economical, except under unusual conditions and great depth of water, to construct the solid type of wharf.

Where the teredo and limnoria are absent and moderate tides prevail and low first costs are desired, the New York pier is preferable. With the same natural conditions, but with a desire for permanency, the Philadelphia design is admirable. Where there is a great variation in water level, especially if seasonal, the Portland plans offer economy and minimum fire risk. With wood borers present and moderate tides and depth of water over firm bottom, Baltimore furnishes an excellent type. For great depths of water and higher tides, the San Francisco pier may well be adapted as a standard.

An 1800-Ton Steel Framework Assembled by Locomotive Crane

THE bag house at Palmerton, Pa., for the New Jersey Zinc Company, has an 1800-ton, 64½ x 805-ft. structural steel framework, 59 ft. high to the lower chords of the roof trusses. It is of regular simple construction, with tall spliced columns and light riveted roof trusses, and has a large number of duplicate panels. The framework contains 162,440 pieces, handled separately in the field, none of them weighing more than 4000 lb. The heaviest ones were assembled by a Bay City 25-ton long-boom locomotive crane which moved from end to end of the building on a longitudinal track, receding from the last finished bent. A considerable proportion of the lighter pieces were erected by hand without the use of the crane. The work involved driving 127,398 steel rivets and placing 70,793 permanent connection bolts and was executed by the Pittsburgh Construction Company.

FORGED IRON AND STEEL produced by rolling mills and steel works in Canada during 1913 aggregated about 23,405 tons, of which about 2578 tons were iron and about 20,827 tons were steel. During 1912 the production was 22,415 tons, of which about 867 tons were iron and about 21,548 tons were steel, according to a special bulletin of the Bureau of Statistics of the American Iron and Steel Institute.

ERECTING A BAG HOUSE 59 FT. HIGH WITH A LOCOMOTIVE CRANE

Steam-Shovel Work at Ashokan Reservoir

Olive Bridge Dam and Dikes of Catskill Aqueduct Involve Excavating and Hauling 6,000,000 Cubic Yards of Backfill from Borrow Pits

THE construction of the Olive Bridge dam and the principal dikes of the Ashokan reservoir for impounding 132,000,000,000 gal. of water for the Catskill aqueduct to New York City involved excavating and hauling of about 6,000,000 cu. yd. of earth for backfill and embankments that are now approximately completed. The excavation has been made entirely by steam shovel, and as only a very small portion of the earth derived from the foundation pits has been suitable for embankments nearly all of the latter have been built from borrow pits. In some cases earth for the same structure was brought from different places at different times and handled by different methods as the work progressed. Careful study was given to the most economical location and operation of the borrow pits so as to secure the greatest ultimate economy for the work as a whole and to meet the varying conditions and requirements of the scheduled progress of the work.

As all of the embankments inclose core walls or other masonry or concrete structures, they could not be built until a large amount of the foundation work and other excavation had been accomplished, so that comparatively little of the embankment earth was handled until the general construction was well advanced. Only about 4,000,000 cu. yd. had been placed at the beginning of 1913 and 1,000,000 yd. more at the beginning of the present year, leaving approximately 1,000,000 yd. more to be placed.

The material is mostly boulder clay. All stones larger than 2 or 3 in. are rejected and the fill is rolled in 4-in. layers on the upstream side and in 6-in. layers on the down-stream side. The more impervious material is selected for the upstream side, and all of it is sprinkled and rolled with special banded rollers, which, at the first rolling, probably penetrate one-fourth of the depth of the layer. They are required to develop a pressure of 30 lb. per square inch of the bearing surface at a penetration of 1 in.

TRANSPORTATION FROM BORROW PITS

Generally speaking, the original surface of the ground was too irregular to permit laying dinkey tracks for dump-cars and was roughly leveled by material delivered in 2-yd. Eagle bottom-dump wagons loaded by 1-yd. steam shovels excavating material from the nearest points available. Afterward 3-ft. gage tracks were laid to the borrow pits, and most of the material was delivered over them in trains of dump-cars. The contract price for the earth in embankment is 60 cents per yard and the average duty of the steam shovel in the borrow pit has been about 12,000 yd. in one month for an 8-hr. shift with a 60-ton shovel delivering to 3-yd. dump cars. For average conditions three ten-car trains are required for each shovel. The average haul is about 1 mi. and the limiting grade about 2.7 per cent for loaded cars.

PLANT

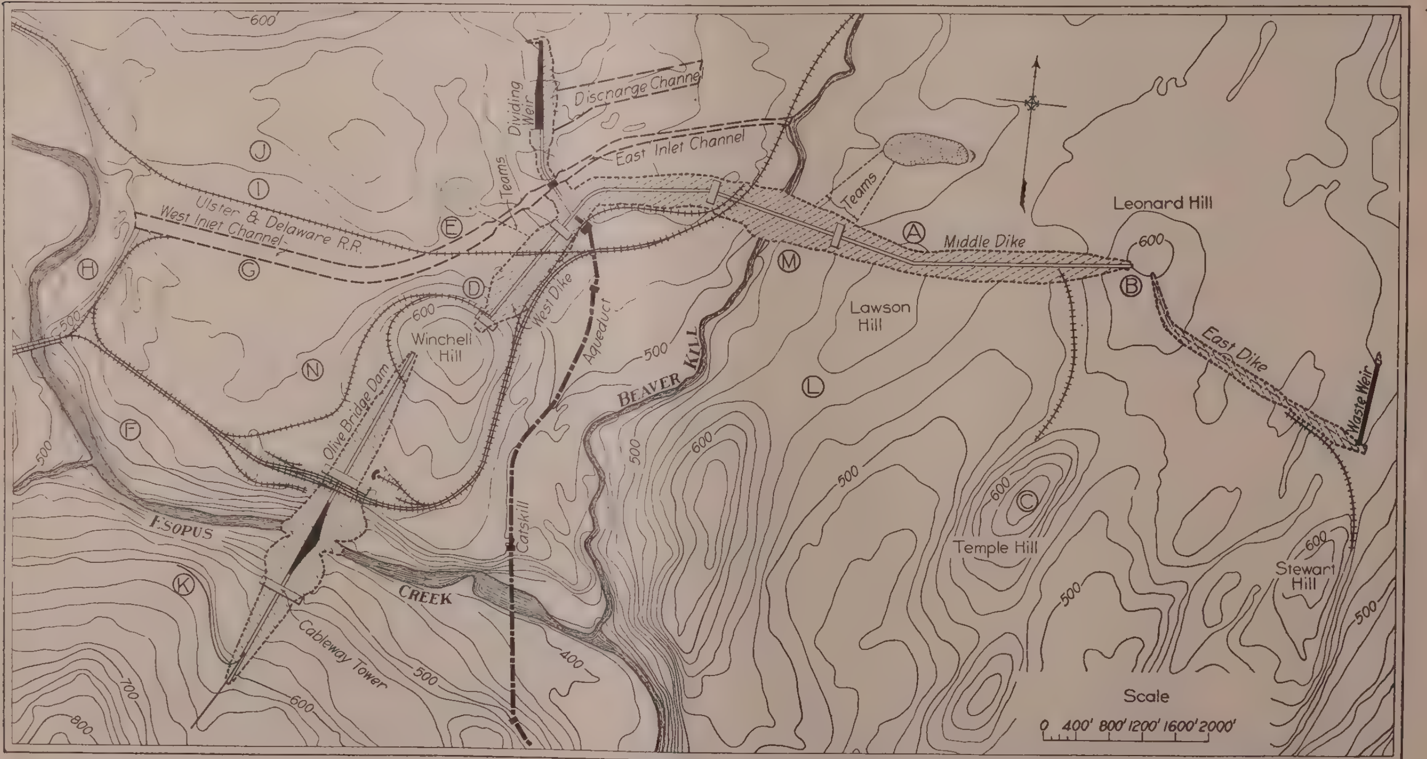
The plant installed varies greatly at different times, but the maximum at any time has been about ten Bucyrus, Atlantic and Marion steam shovels, about twenty-two American and Vulcan dinkey locomotives, about 300 Western dump cars, three well drills, six Monarch steam rollers and about 15 mi. of 3-ft. gage track laid with 45-lb. rails. Attempts were made to distribute the earth in the embankment with mechanical spreaders of various types, but these were found unsatisfactory on account of the large amount of stones contained in the earth, and all of the distribution was done by hand.

EAST DIKE

The east dike is 3300 ft. long, with a maximum height and bottom width of 35 and 195 ft., and contains about 185,000 yd. of embankment. The embankment was started on the stripped surface of the ground, except for an area of about 33,000 sq. ft., where the swampy soil was excavated 3 or 4 ft. deeper to solid, impervious material. All of the material was excavated from the Stewart Hill borrow pit located 1500 ft. from the nearest end of the dam. The work was of a very simple, regular character. There was installed first a small Thew and later a large Bucyrus steam shovel. The latter delivered an average amount of 10,000 yd. per month to the two ten-car trains drawn by dinkey locomotives.

WEST AND MIDDLE DIKES

The west and middle dikes have a combined length of 9000 ft., a maximum height above the original surface of 110 ft., and a total amount of 3,800,000 yd. earth in embankment. Their construction was greatly impeded and the steam-shovel work was seriously restricted by the large excavation 80 ft. below the surface for a submerged dam in the bed of the Beaver Kill and for core-wall foundations 40 ft. below the surface in the bed of the Hog Vly Kill and on account of the necessity of maintaining traffic on the two intersections of the Ulster & Delaware Railroad, which crosses the dikes near the elevation of the original surface of the ground and could not be relocated until after the dike construction was well in progress. As the embankments adjacent to the tracks were required to have slopes not exceeding 1:3, and as the tracks were oblique to the axis of the dam, very wide spaces were required for them, dividing the work into several sections and making it impossible to carry on the construction uninterruptedly from



MAP OF PART OF ASHOKAN RESERVOIR, SHOWING LOCATION OF DAM, DIKES AND BORROW PITS

BUILDING EMBANKMENT INCLOSING CORE WALL OF MIDDLE DIKE

end to end of the dike at the beginning of operations. Eventually concrete arches were constructed over the tracks, as described in the Engineering Record of Nov. 9, 1912, page 530, thus permitting the embankments to be built over them while the traffic was maintained in tunnels finally closed and filled after the railroad service had been transferred to new tracks located above the submerged area.

Earth for the middle dike embankment east of the Beaver Kill was first excavated in a borrow pit at Temple Hill, about 3000 ft. from the east end of the dike. The steam shovels here worked entirely around the hill, and as the elevation of the top of the embankment was gradually raised the track was correspondingly raised on the slope of Leonard Hill until it was carried across Lawson Hill and eventually along the middle dike to its western end on Winchell Hill, a distance of about 1 mi. Before the Temple Hill borrow pit was opened a borrow pit was excavated on the east side of Lawson Hill for the preliminary fill of the east end of the middle dike and another steam shovel was installed in a borrow pit on the west side of Lawson Hill, which furnished earth for filling in the deep excavation of the Beaver Kill. Efforts were made to secure earth from a borrow pit at the intersection of Beaver Kill and the middle dike, but the earth there was so rocky that it was not acceptable, and this borrow pit was abandoned.

The cableways installed over the Beaver Kill and Hog Vly Kill for excavating and concrete work were also used for handling the soil excavated in borrow pits by the steam shovel, loaded into 5-yd. skips and delivered over the standard-gage tracks. This earth when dumped through a minimum depth of 4 ft. of water was considered as satisfactorily puddled and was not rolled or rammed. A steam shovel installed in the borrow pit E, just north of Winchell Hill, delivered to teams which distributed the earth for leveling up the original surface of the ground under the west dike.

The west inlet channel was excavated simultaneously with the construction of the west dike, and about 600,000 yd. of it were used for the middle dike, although about 300,000 yd. were wasted because it was necessary to push the excavation through the winter months, when it was not possible to build embankments. Much of this excavation was also unsuitable for the dike. The excavation of the inlet channel was extended northward at I to provide additional material for the embankment and another borrow pit, J, was opened adjacent to it and yielded about 300,000 yd. of embankment material.

After the work had progressed far enough to permit running the dump cars on top of the finished east end of the dike, steam-shovel work was resumed in the Temple Hill borrow pit and material from there was used on the dike between Lawson Hill and Winchell Hill. In a few cases the soil was hauled on a track laid on top of a core wall, but generally the tracks were carried on the surface of the embankment.

OLIVE BRIDGE DAM

Both ends of the masonry structure of the Olive Bridge Dam across Esopus Creek terminate in long, high embankments with concrete core walls, and the foot of the upstream face of the masonry structure is protected by a long, flat slope of earthfill. The total length of the Olive Bridge dam is 4620 ft. and it contains about 2,000,000 yd. of embankment. Earth for the south embankment was largely excavated in borrow pit F, delivered in skips on standard-gage cars, carried across the creek by the cableway, and dumped as required. Most of the earth for the north end embankment was excavated in pit N until the embankment was high enough to allow the track to be laid over the finished masonry, and since that time the earth has been excavated in borrow pit K and delivered thence in dump cars. About 60,000 yd. of embankment on the upstream face of the masonry part of the dam have been deposited under water by cars dumping it from the crest of the dam and from the cableway.

A large amount of the earth excavated by the steam shovel is so hard that it first requires to be shattered, which is accomplished by drilling 6-in.-diameter holes to the full depth of the cuts with steam well-drilling machines. These holes are first sprung and then fired with larger charges, carefully proportioned to loosen the earth without throwing much of it down. Both black powder and dynamite are used, depending on the character of the soil. The work is being executed under the direction of the Board of Water Supply, of which J. Waldo Smith is chief engineer, Winston & Company are the contractors.

Dredging Progress on the Columbia River Bar

Large Scraper-Suction Dredge Remodeled for this Work, Shows Good Results

THE scraper-suction dredge Chinook, used by the United States engineers in maintaining the channel over the bar at the mouth of the Columbia River, has been extensively remodeled this year and since July 1 has been in service, using the new equipment. Before the changes were made the dredge had two 20-in. pumps and normally handled from 8000 to 9000 cu. yd. per 16-hr. day. Two 30-in. pumps have been installed in addition to the others, and the maximum capacity per 16-hr. day is now found to be from 20,000 to 22,000 cu. yd.

The Chinook has a hopper capacity of 3000 cu. yd., and when working on the bar the trip to dumping ground and back averages a total of 3 mi. On this basis the total yardage handled during August was 327,460, at an operating cost of slightly over four cents per yard. Of this total 209,640 cu. yd. were taken from the bar, and 117,820 cu. yd. from inside the bar on days when it was too rough to work outside. The average quantity of material moved

EXCAVATING AT BROCKS BORROW PIT FOR DIKE EMBANKMENT per day during August was 14,000 cu. yd., based on the following apportionment of effective working time :

Pumping	165 hr.
Dumping	17 hr.
Going to and from dump	65 hr.
Turning in cut	13 hr.
Total	260 hr.

Some time was lost in steaming out and back on the days when it was found to be too rough to work effectively on the bar, which reduced the number of working hours considerably. This, in conjunction with the time lost in taking oil and washing boilers, accounts for a daily average as low as 14,000 cu. yd. for August, in which month the maximum yardage handled in 16 hr. was 21,500.

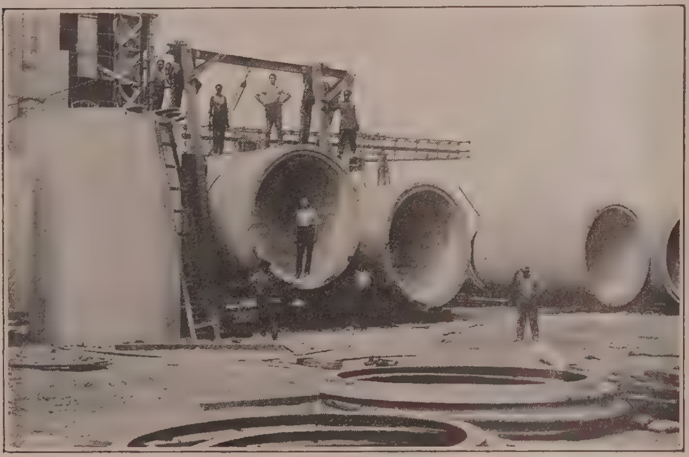
STILL LARGER DREDGE PROPOSED

Dredging on the bar is always difficult, even in comparatively calm weather, because of the rough water. In fact, during the winter season it is not practicable to attempt to carry on this work at all. However, the urgent need of a permanent channel across the bar 30 ft. or more in depth led to the proposal last year that $1,500,000 be appropriated for a hopper dredge of very large proportions, with which work could be accomplished expeditiously in fair weather. A great deal of pressure was brought to bear in favor of this measure, but it was finally decided that the Chinook should first be equipped for a greater capacity, as already described, and if results were sufficiently encouraging, the larger dredge could then be built and used in conjunction with the Chinook.

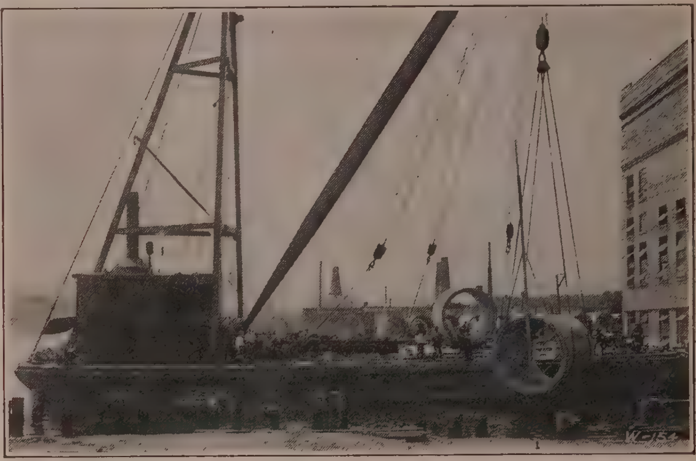
Meanwhile a study is being made of the requirements of the big dredge, and plans are being drawn tentatively. After two months of service the indications are that the Chinook will continue to give entirely satisfactory results, so far as her capacity goes. Final decision on the bigger dredge, however, is not likely to be made until after the next open season.

The work on the Columbia River bar is under the direction of Lieut. Col. C. H. McKinstry and is being carried out under the personal supervision of Gerald Bagnall, U. S. assistant engineer.

THE CONTRACTORS for the Catskill aqueduct concrete bridge described on page 274 of the Sept. 5 issue were Ward & Tully, Inc., and not Ward & Kelly, Inc., as printed.



TURNING PIPES FROM VERTICAL TO HORIZONTAL POSITION



PLACING PIPES UNDER WATER WITH FLOATING DERRICK

Concrete Pipe for Subaqueous Tunnels

Part II—Methods and Costs of Turning Sections on Their Sides and Laying Them under Water from Derrick Scow

By J. C. LATHROP
Civil Engineer, Consolidated Gas, Electric Light & Power Company, Baltimore

THE manufacture of twenty-nine reinforced-concrete pipe sections for the Consolidated Gas, Electric Light & Power Company of Baltimore was described by the writer in the Engineering Record of Aug. 15, page 194. As the pipes were built standing on end, it was necessary to place them in a horizontal position so they could be rolled to the water's edge and taken on board the derrick scow used for laying the sections under water. This portion of the work was accomplished in a period of eleven days by an ingenious method devised by J. C. Mitchell, general manager of the Lock Joint Pipe Company.

The two A-frames, consisting of 8 x 8-in. timbers, were supported on two 10 x 14-in. timbers and carried across their top an 8-in. 18-lb. I-beam, from which was suspended the full weight of the pipe. A 12 x ½-in. plate was made to fit one-half the circumference of the pipe. On each end of this plate was fastened a one-half sheave in which was reeved a 1-in. steel cable passing around the other half of the circumference of the pipe. This drew the plate tightly against the concrete when a strain was placed on the 1-in. cable. The ends of this cable were fastened to a two-sheave block. From this block a ½-in. steel cable was reeved through a three-sheave block, which was attached to the 8-in. I-beam by a heavy shackle. The ½-in. cable was carried through a single sheave fastened to the 10 x 14-in. timber at the base of the A-frame and thence to the hook of a 3-ton chain block attached to the overhanging end of the 8-in. I-beam.

The above describes one-half of the equipment, there being two such sets of sheaves and chain blocks. When a strain was placed on the cable by means of the chain blocks, each of which was readily handled by one man, the tension in the ½-in. cables drew the 1-in. cable and the 12 x ½-in. plate tightly around the pipe, so that it might be lifted until it swung clear of the ground. It should be noted here that this attachment to the concrete pipe was placed ½ in. below the center, in order that it might swing to a horizontal position after being raised. A block and tackle were arranged so that this motion might be controlled. After the pipe was turned into a horizontal position it was carefully lowered on skids and securely blocked in place.

COST OF TURNING PIPES

The cost of this portion of the work was as follows:

COST OF TURNING PIPES ON SIDES

Assumed rental and depreciation of equipment	$125.00
Foreman, 11 days, at $5	55.00
Labor, 622 hrs., at 17½ cents	108.85
Total	$288.85
Cost per linear foot of pipe	66 cents

While the pipe was being manufactured by the Lock Joint Pipe Company, the piling for the support of the tunnels had been driven by another contractor, under specifications which provided that each pile should be driven 10 ft. after the penetration under the blow of a 3000-lb. hammer falling 10 ft. did not exceed 3 in. This provision was made so that the piles would have ample strength in bending, as no diagonal bracing could be used. A contract was made with the Merritt-Chapman Wrecking Company for cutting off the piles at the proper level, capping the same with 12 x 12-in. yellow-pine timbers and laying the pipe.

The hard bottom, which was covered with a deposit of fine silt, had been dredged 2 ft. below cutoff, but when the contractor began cutting off and placing caps it was found that the silt had washed around the piles to a depth of from 6 in. to 2 ft. above the cutoff. As the removal of this mud, which was accomplished by a mud pump and an orange-peel bucket, caused considerable delay, the actual laying of pipe did not begin until Aug. 20, 1914.

PLACING PIPES

During this period a dock was built, upon which the pipes could be rolled within reach of the floating derrick, two or four sections being taken on the scow at one time. Each section was placed in a cradle consisting of two 12 x 12-in. yellow-pine timbers 12 ft. long, tied together by two 1½-in. bolts, through gas-pipe separators, so arranged that the bottom of the concrete pipe would come 5 in. above the bottom of the timber caps.

After the pipe and cradles had been assembled upon the deck, they were lifted by the derrick, as shown in one of the photographs, and carefully lowered until the cradle was within about ¼ in. of the caps. The pipe section was then drawn into place by two divers by means of threaded rods which passed through angles bolted to the cradle. As the sections were placed, the joints between the bell and spigot were calked by one of the divers.

The total cost of cutting off and capping the piles and laying the concrete pipe would be very difficult to determine accurately, due to the extra work required in removing mud, the questions as to the value of the equipment and amount to be assumed for overhead, and the salaries and wages paid the men. The following data, however, might be of assistance when estimating similar work.

The floating derrick used had a capacity of 50 tons and is probably worth not less than $75,000. The usual crew consisted of one general superintendent, one captain, two divers, two helpers, two carpenters and five laborers. With this crew and equipment the contractor could cut and cap an average of about twelve piles per day of nine hours.

With the exception of the two sections adjacent to the intake tunnel, which required three full days to place, the tunnels were laid at the rate of two sections per day.

Applicability of Yellow-Pine Grading Rules to Other Timbers

Criterion of Density Must Be Based on Characteristics of Each Species

By J. A. NEWLIN

In Charge of Timber Tests, U. S. Forest Products Laboratory, Madison, Wis.

[A large purchaser of timber recently asked this journal as to the extent to which the grading rules adopted by the Yellow Pine Manufacturers' Association on March 4, 1914, published in the Engineering Record, May 23, 1914, page 579, could be applied to other species of timber. The likelihood of general interest in the question prompted a request that Mr. Newlin discuss it for publication. The present article explains clearly the limitations as to the applicability of the rules.—EDITOR.]

IN any one species of wood there is considerable variation in density and strength, this variation of course being much greater in some species than in others. In species having but comparatively little variation present conditions would not justify any density requirement. On the other hand, unless some quality classification is made in those species which show a wide range, the better material must necessarily be placed on a par with the poorer. Each of the Southern yellow pines show a comparatively large variation in density and strength. This, combined with the recognized impracticability of distinguishing lumber of these species, makes a quality classification most urgent. The rules adopted by the Yellow Pine Manufacturers' Association were formulated to establish a quality grade for Southern yellow pine.

With the exception of the place where the rings are to be counted and the summerwood measured, the grading rule might be applied to Douglas fir. The modification is necessary because Douglas fir comes from large trees and much of it is not cut box heart. In fact, the grading rule itself is applicable to all species, but the criterion for dense wood is not entirely applicable to any but the Southern Pines.

That strength increases with increasing density is the most general law of timber physics. Not only does this law apply to different pieces of the same species, but also between the different species, with but slight variations. The best criterion of density is the weight of a given volume of dry wood. This criterion is applicable to all species and could be used in grading, although it would require a little apparatus and special training for the graders.

If a visual inspection is to be used for determining density a study of the characteristics of each species must be made in order to formulate rules applicable to the different conditions. It has been found by numerous tests that in species which show a marked contrast between the springwood and summerwood of the growth rings the proportion of summerwood gives a good indication of the density. The species having a distinct difference in springwood and summerwood and those showing no marked contrast are about equal in number, but the former class furnishes by far the greater part of the lumber produced. Important species showing a marked contrast in springwood and summerwood are the Southern yellow pines, Douglas fir, larch, the oaks, ashes, hickories, etc., while the white pines, spruces, maple, beech, etc., belong to the group where springwood and summerwood are not easily distinguishable.

SUMMERWOOD IN DIFFERENT SPECIES

The same proportion of summerwood in the different species does not necessarily mean equality in density or strength, as this criterion can only be used for comparisons within a given species or between those shown by test to have equal strength values with equal percentage of summerwood. Thus in a piece of black locust and a piece of Southern yellow pine containing the same proportion of summerwood the locust will invariably be the stronger. On the other hand, the difference in strength between longleaf pine and Douglas fir with equal percentages of summerwood is not very great, although no accurate determinations have as yet been made. It is expected that data along this line will be available in about six months.

The requirement of 25 per cent of summerwood for material of eight rings or more per inch is quite liberal and would admit most longleaf pine and Douglas fir. Probably more than one-half of these species would pass a 33 1/3 per cent requirement.

The relation of the rate of growth or number of rings per inch to strength is quite variable. The rate of growth in itself appears to have nothing to do with the strength, but in most species certain rates are favorable to the production of dense wood and thus indirectly furnish an indication of strength. The conifers usually have a normal rate of growth which is productive of the best material. Exceptionally fast, and, frequently, very slow, growth are likely to produce material which is lacking in density. In the ring-porous hardwoods, such as the oaks, hickories, ashes, etc., as a general rule, the more rapid the growth the denser and stronger will be the material. This rapid-growth stock goes under the name of second growth, and second growth is often specified in buying hardwoods for handles, etc. The proportion of summerwood has been used for several years in grading hickory wheel-stock.

As indicated before, the quality classification is most urgent in the Southern yellow pines. The Yellow Pine Manufacturers' Association's grading rule is a step toward such a quality classification. The rule may be applied to all species, but the criterion for density must vary with the species if a visual method of determining density is to be used.

Information Desired for Federal Valuation

Abstract of Official Railroad Bulletin, Specially Pointing Out Various Elements of Value Not Readily Discernible

WHEN the Federal valuation act was passed a year and a half ago a few of the railroads had made similar investigations of their own, and were well prepared to co-operate with the Government, but the majority were not so equipped. Valuation committees and officials have been appointed on most of the large roads, and it is certain that much study has been given to the details as well as the general principles of the work. Little information as to the work of these committees has been given out, which leads to the belief that on many of the roads full plans of action have not yet been evolved. Hence it is hoped that the following, pertaining particularly to obscure and extraordinary items of value, may be generally helpful, being an abstract of a bulletin entitled "Information Desired for the Federal Valuation," issued by Charles Hansel, chairman of the valuation committee of the Central Railroad of New Jersey, and placed in the hands of all employees of the company.

OBSCURE ITEMS

In order to co-operate with the Interstate Commerce Commission, under the Federal valuation act, in the preparation of an inventory of the properties embraced in the Central Railroad of New Jersey system, representatives of the railroad will accompany the Government survey parties to point out the nature, locality, extent and corporate ownership of such properties. In addition to being familiar with the maps, profiles, plans and schedules of the properties, these representatives should have knowledge of all obscure and extraordinary items, quantities and costs that are not readily visible or determinable upon a field inspection.

A few examples of such special features of construction are:

Sunken embankments.

Old excavations filled up.

Trestles and other structures which have been filled with earth embankment.

Sink holes.

Cuts which were wet during construction and therefore caused extraordinary costs, but which are now dried out.

Disintegrated or earth-covered rock cuts, which might now be classified as earth at a low price when compared with the original cost of rock excavation.

Temporary roads, trestles, tracks, embankments, dams and other structures required during construction, traces of which have disappeared.

Excessively costly foundations of bridges, buildings and other structures.

Unsuspected drains and culverts.

Conduits, sewers, catchbasins, water pipes, dikes, dams, cribbing, retaining walls, flumes, ditches, riprap, mattresses, etc., not readily discovered, and especially those which are outside of the right-of-way.

Roads, channels and streams which have been diverted, but knowledge of which cannot be had from mere inspection.

Materials which were originally ballast, but which have settled below the subgrade.

Items incident to eliminating grade crossings, elevating, depressing or changing tracks, particularly under traffic, and similar extraordinary construction costs.

Penalties paid contractors for delay in furnishing material or facilities.

Extra cost of work owing to extraordinary weather and labor conditions, strikes, etc., or on account of suspension and later resumption of the construction.

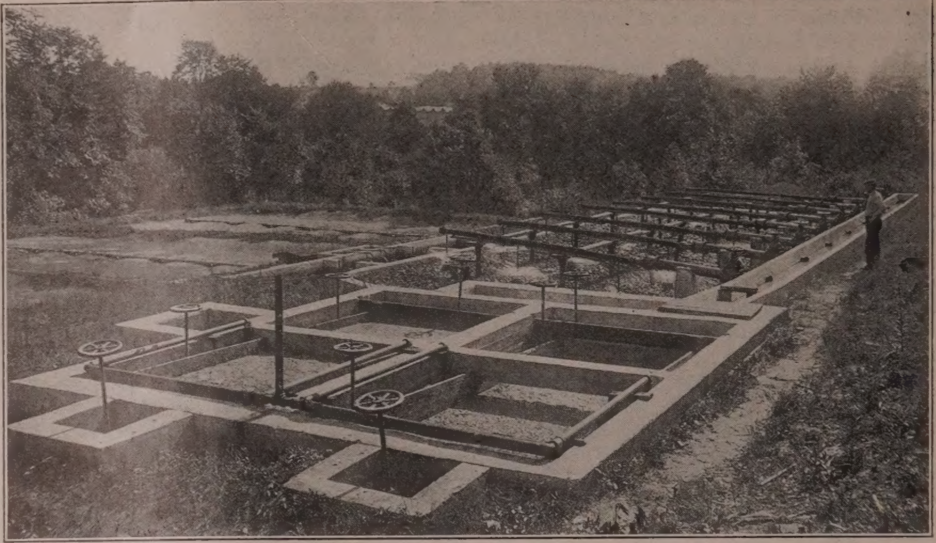
Curbing, paving, drainage, etc., of streets, and other improvements of various kinds off the right-of-way, paid for wholly or in part by the railroad companies.

Special assessments levied against the railroad companies for general public improvements.

PERSONAL KNOWLEDGE

It is evident that information concerning such items as these can, in many cases, best be ascertained from a personal recollection and knowledge of conditions attendant upon the construction, improvement and operation of the property. Therefore, in order that a comprehensive investigation and study of the construction records may be made, any person having information of the nature desired is earnestly requested to communicate in regard thereto with the principal assistant valuation engineer.

It is important that such communications should give, if possible, the description and location of old field books, maps, profiles, plans, final estimates, vouchers, reports of engineers, "authority for expenditure" reports, and any other records containing information of the nature above described which may be in the general, division or other offices of the company or in the possession of contractors or others who have had connection with the construction, extension and improvement of the road, but who are not now in the employ of the company; also the names and addresses of retired or former officers and employees and others who may have knowledge of the construction, extension and improvement of the property.



MOUNT GRETNA SEWAGE PLANT, SHOWING SPLASH PLATE DISTRIBUTION AT FILTERS

Mount Gretna Sewage Plant

Design and Operation of Pennsylvania Works where Tank Effluent is Applied to Slag Filters by Splash Plates

By M. H. MATTHES
Engineer, Department of Internal Affairs, Pennsylvania

MOUNT GRETNA is a summer resort in the Blue Mountains of Pennsylvania, 22 mi. from Harrisburg. Its sewage-treatment plant, designed by James H. Fuertes, of New York, was built in 1911, and serves a population varying from 3000 to 4500. The plant consists of two sedimentation tanks, modifications of the Imhoff tank, a percolating coke filter with downward-flow streams and splash plates, three settling chambers, dosing chambers, three intermittent sand filters and a sludge bed.

The two concrete sedimentation tanks have a combined capacity of 8500 gal. A wood false bottom in two parts sloping downward from the sides of each tank and overlapping each other is placed 3 ft. from the bottom of each tank, the lower space holding approximately 10 cu. yd. These false bottoms are built between the two end baffles, under which the sewage enters and leaves the tanks, thus providing for a practically undisturbed flow line, as the sewage is drawn from a depth of 3 ft. below the surface. This provision excludes the drawing off of grease and finely divided grounds, which would clog the filter. Sumps in each tank connect to a 10-in. pipe to the sludge bed adjoining.

PERCOLATING FILTER

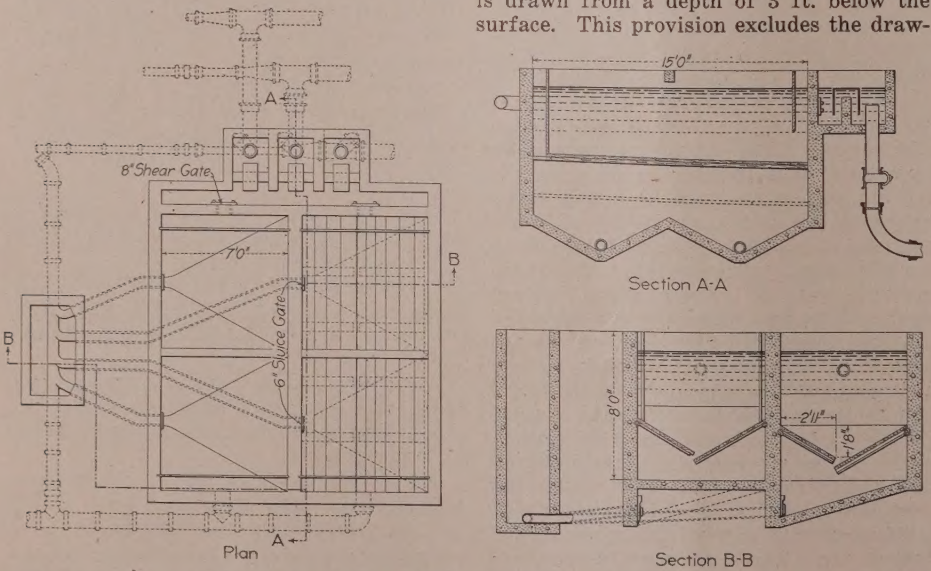
The percolating filter is 31 ft. wide, 78 ft. long, and 5 ft. deep, hard burned slag being the filtering medium. The side walls are of sandstone, with a concrete rim on the top, allowing for thorough aeration of the bed. Eight 6-in. cast-iron pipes extend diagonally across the filter from a concrete flume and are supported by 4-in. cast-iron upright pipes. At 7-ft. intervals along the 6-in. feeders holes are drilled in the lower side for ½-in. brass tubes discharging downward into a circular brass cup, supported by a small concrete pier laid in the slag. All distributing parts are exposed for inspection and repair, which is quite an advantage.

The collection system consists of bricks set on edge, leading to an 18-in. concrete channel. A fall of 6 in. assures sufficient head for good drainage. This channel has three outlets of 4-in. terra cotta pipe leading into the settling tanks and dosing chambers.

These three chambers are built of concrete, 15 x 18 ft. and 3 ft. 9 in. deep to the flow line. The two end tanks are used for settling, and the central one for the discharge through the siphons. The three siphons are of the Merritt aerlock type, and trip automatically in series, dosing the three sand filters at regular intervals in series.

DISTRIBUTION SYSTEM

Each of the three sand filters is 74 ft. long, 44 ft. wide and 5 ft. deep. The distribution system consists merely of an 8-in. terra cotta pipe, cement-jointed end to end, laid on the surface of the filter and extending the full length. At 10-ft. intervals 3-in. short tile pipes are attached on both sides, discharging upon a wood splash board, or spreader, which prevents the destruction of the sand bed at the beginning of a dose.



PLAN AND SECTIONS OF IMHOFF SEWAGE TANKS AT MOUNT GRETNA

The collection system consists of two 6-in. pipes laid in each side of each bed, extending the full length and discharging into Conewago Creek. This stream empties into the Susquehanna River below Middletown, Pa., and while there are no municipalities drawing on it for their source of supply, still there is one large ice dam at Colebrook, 3 mi. below the treatment plant.

Operation

Sewage from the grounds is led to the plant through the outfall sewer, and enters the sedimentation tanks, where the heavier solids are deposited. At present, under an extremely light sewage flow, from 6 to 7 hr. sedimentation is afforded. Later, when the flow increases, the duration of the period of retention in these tanks will necessarily decrease. But in two years of operation, particularly at the beginning and ending of the seasons when the contributing population is small and the retention period long, there was no evidence of septic action.

The effluent from these tanks is thoroughly screened before passing down the concrete channel to prevent clogging the sprinklers or the bed itself. The main feeders extending from this channel are all valved, so that precise regulation of them governs the equal distribution of sewage over the bed, but owing to the fact that the sewage flow varies greatly each day the inverted cups vary in performing their work. At times each cup is spraying over a radius of 8 ft., while again it is merely overrunning the cups. However, as that method is comparatively new, complete success cannot be expected at once, but the operator in charge of the plant, the master carpenter of the Cornwall & Lebanon Railroad, has been experimenting with the valves in order to obtain a constant spray from each cup.

A weir was installed in the flume supplying the coke filter, and nail notches, for the purpose of permanency, were driven so that a glance shows the sewage flow at any time. Hourly readings were taken and these results were later checked with the amount siphoned, making full allowance for the sewage flow into the dosing chamber during the time of the dose. The size of each dose is 7500 gal. and there are an average of nine doses a day, ten being the highest recorded, and seven the lowest, which gives an average maximum sewage flow of 75,000 gal. daily, which checks with the weir measurements very closely. This flow will increase greatly, as not all of the cottages on the grounds are occupied.

Rate of Flow

Assuming that the present average sewage flow is 70,000 gal. daily, the slag filter is operating at a rate of 1,300,000 gal. per acre per day—an extremely low rate for such a filter—and the flow can double before any steps need be taken to enlarge the filtering area.

The sand filters have been operating at a rate of 310,000 gal. per acre per day, which might be considered higher than the limit agreed to in successful practice, but the preliminary treatment afforded this sewage must be considered. The size of the stream into which the sewage is discharged, the character of the raw and treated sewage and the use of the stream as a source of supply are all to be considered in determining the degree of purification to be obtained by any plant in the State, as all plans and specifications must be approved by the State Department of Health before a permit to construct is issued. In this case the stream has a drainage area above the plant of 2.43 sq. mi. Measurements taken of the flow by engineers of the State Water Supply Commission show that it was 0.07 sec. ft. per square mile, which, however, was in an exceedingly dry season and gives a minimum flow of 113,000 gal. per day. The general average daily flow can be safely estimated at 500,000 gal. per day.

Ratio of Dilution

Various reports by eminent sanitary engineers state that the ratio of dilution of raw sewage to water should be at least 1:50. In this case the ratio of dilution of filtered and treated sewage to the water is 1:7. This ratio seems very low, but the degree of purification obtained must be considered. Then, too, the stream is not used as a source of supply by any municipality. The raw sewage is very dilute, containing no trade or industrial wastes.

Methylene blue stability tests of the effluent always show a stability of more than 120 hr. at which time the sample is destroyed, for the assurance is given of a nonputrescible effluent.

Book Reviews

Technologic Paper 38 of the Bureau of Standards, on "Observations on Finishing Temperatures and Properties of Rails," has been issued. It was prepared by G. K. Burgess, physicist; J. J. Crowe, assistant physicist; H. S. Rawdon, assistant physicist, and R. G. Waltenberg, laboratory assistant. It contains 63 pages, fifteen figures and thirty-one tables. The topics discussed are the importance of limiting temperatures of rolling rails, methods of measuring rail temperatures, M. H. Wickhorst's experiments, measurements of ingot and finishing temperatures, samples and chemical analyses of rail steels, mechanical properties of rails, melting temperatures of rail steels, critical ranges of rail steels, observations on microstructure, temperature distribution in a cooling rail, expansion of steel rails, and the "shrinkage clause" in rail specifications. The paper is mainly a record of observations, which are summarized in the last three pages. (Washington, D. C., Department of Commerce.)

ELEMENTARY PRINCIPLES OF SURVEYING. By M. F. M. Ormsby, Lecturer in Surveying at University College, London. Cloth, 4½ x 7½ in.; 230 pages; 138 diagrams and illustrations, including four folding plates. London, Scott, Greenwood & Sons. New York, D. Van Nostrand Company. $1.50 net.

(Reviewed by A. F. Comstock, Associate in Railway Engineering, University of Illinois, Urbana.)

The author makes it clear in the preface that this work is not intended to be a complete treatment of the subject, but rather an introduction to some of the more complete manuals. Attention is called to the dearth of acceptable textbooks upon the subject, although in the United States such a need is probably not so generally felt. The book is divided into six chapters, the titles of which are: "Chain Surveying," "Traverse Surveying," "Leveling and Contouring," "Triangulation Surveys," "Tachometric Surveying" and "Curve Ranging." While much space is occupied with a clear discussion of sound principles of surveying, to which little exception can be taken, there are several reasons why the book is not adapted to American needs. Among these are the relatively large amount of attention given to the gunter's chain, which is the English standard for land surveying and railway curves; differences between American and English practice, and limitations in the scope of the book.

BUSINESS ADMINISTRATION, ITS MODELS IN WAR, STATECRAFT AND SCIENCE. By E. D. Jones. Cloth, 5 x 7½ in., 275 pages. New York, Engineering Magazine, $2.

The title well outlines the scope of the book. Professor Jones has taken as his thesis that since those responsible for the success of our vast American enterprises have with few exceptions been secretive regarding their ideals and the philosophy of their detailed methods, we must turn for models of administration to the treasury of history, where lie abundant sources as to the methods which have won success in war, statecraft and science. The book does not lay down ready-made administrative systems built on the data discussed. It is rather a book of inspiration, furnishing material and suggestions from which the administrator can fashion a model for his own organization. It furnishes, too, a series of standards—not formulated and catalogued as such, but scattered here and there, mainly in the conclusions following the chief sections of the book—by which the executive can judge of the relative excellence of the ideals animating his own industrial machine.

There are three main divisions in the book. In the first the administrator is considered as a general, the leader of an industrial army; in the second, as a scientist; in the third, as a diplomat. A summary chapter closing each section aims to crystallize the principles which the previous discussion has revealed. Some of the section headings and epigrammatic sentences alone justify a reading of the book. For example, one section is entitled "Persistent Thinking as the Universal Solvent," while elsewhere are found such sentences as the following: "One must learn, must practise persistently, even fight strenuously, for the right to bring all his powers to bear on his life work." "The root evil of life is cowardice, and the basic virtue bravery."

Against one point, however, the reader should be warned—Professor Jones' failure to see any good whatever in the Middle Ages. True that period is generally estimated from prejudiced standpoints, and from the standards of to-day. Considered in their chronological position in history, however, and comparing them with the ages preceding, their record deserves more sympathetic consideration than is given them by Professor Jones. Nor will their lack of enlightenment be attributed to the causes assigned by Professor Jones.

WATER SOLD THROUGH METERS in Harrisburg, Pa., nets 86 per cent of the total receipts. All but 3378 of the 18,579 taps were metered at the close of last year according to the last annual report of the Water & Light Department. Consumption amounts to 179 gal. per capita and 477 gal. per tap. The cost of supplying water figured on total maintenance is $19.19 per million gallons. Adding sinking fund and interest in bonds brings this amount to $39.53. By the high duty pump, working against a dynamic head of 235 ft., the pumping cost is 2.1 cents per million gallons raised 1 ft., while 247 gal. are pumped per pound of river coal which costs $1.25 per ton.

Letters to the Editor

Testing Concrete Aggregates

Sir: The practical value of any laboratory test of the materials of construction is in direct proportion to the degree of accuracy with which the test indicates those qualities of the material which it must possess in order to perform properly its functions in the finished structure.

Without going into a discussion in detail of Mr. Johnson's comments, abstracted in your issue of Aug. 29, page 248, in the matter of testing concrete aggregates it seems desirable to point out and emphasize the salient points which must be kept prominently in mind when considering any test for materials of this character. One of these is that "ideal" conditions are not to be sought. They are not desired. They would produce, if attached, only "ideal" results. What are wanted are purely practical conditions in order that we may secure practical results.

Another point to be remembered is, that the problem is to produce a method of test which will determine which of two or more aggregates will produce the strongest concrete—not which aggregate is in itself the hardest, or densest, or has the greatest compressive strength, or excels in some other quality. The one thing to be determined is the quality of concrete it will produce, and the only way to do so is to test it in the form of concrete in some manner or other. To do this satisfactorily there should be but one variable entering into the test and that variable should be the aggregate itself.

In the test as developed in the laboratory of Westinghouse Church Kerr & Company there has been an effort made to eliminate as many variables as possible. The grout used is, of course, "standardized" as previously mentioned. The sand used for the grout in the tests reported was carefully sized by screening.

The test offered may not prove equal to the demands for materials of this nature. The way to find out is to try it. Improvements can undoubtedly be made and perhaps some entirely different methods will be developed, but neither improvements nor new methods will be developed with the pen or on the convention hall floor; they must be worked out in the laboratory or in the field.

It is greatly to be hoped that with so many vitally interested in the problem there will be much done in the near future in the way of investigation and tryout.

Cloyd M. Chapman,
Engineer of Tests, Westinghouse Church Kerr & Company.
New York City.

Advertising in South America

Sir: Of late we have heard a good deal about South American trade and the way to capture it from the Nations now at war, but sufficient emphasis has not been laid on the advertising side of the question.

Being thoroughly acquainted with the foremost South American country—Argentina—perhaps I may be allowed to make a few remarks on the subject.

From a sentimental point of view the United States, overlooking some little ill-feeling created by its relations with some Latin-American countries north of the equator, has a great advantage over its non-Latin competitors. On the one hand England once made an unsuccessful attempt to capture Buenos Aires by force of arms, and to this day the Calle Reconquista yearly celebrates the defeat of the English expeditionary force. Although Germany never made any military demonstration against Argentina, yet it has helped to build the Chilean army into the efficient fighting machine it is to-day, and this machine threatened for several years to cross the Andes and sweep the Pampas. Besides, it is well known that Germany has enormous interests and large colonies in Brazil, which country is not, chiefly for racial considerations, on very friendly terms with Argentina.

With the exception noted above, there should be nothing but good feeling for the United States in Argentina. The American Revolution undoubtedly gave an impetus to the movement for Argentine independence, the Constitution of the United States practically served as a model for that of Argentina, and in International relations the Monroe doctrine has insured the South American republic against the land-grabbing propensities of some European countries. Yet, in spite of all this, the United States has had to take a back seat in Argentine trade while Britain and Germany have captured the market.

That their success is not due to inferiority in quality and to exorbitant prices of United States goods is proved by the fact that the United States can, and does, successfully compete in some branches of trade in the home markets of the very countries which have ousted it in Argentina.

The main reason of the failure lies in the inadequacy of advertising. What constitutes excellent advertising for the home market may, and very often does, prove an utter failure in foreign ones. One cannot fail to feel the enormous difference between the United States and European and Latin-American countries by glancing at the advertising pages of the engineering as well as the daily papers of the different Nations. But perhaps the manufacturers of the United States do not read foreign papers, otherwise they would soon adapt themselves to foreign ways and methods and "in Rome, do as the Romans do."

Besides the temperamental idiosyncrasies which react on all branches of trade, there is one mighty difference between the two countries which affects engineering manufacturers, and it is this, that whereas in the United States a large percentage of the public purchasing building implements and materials have absolutely no technical knowledge whatsoever, the Argentine firms likely to buy from American manufacturers do have in their employment men who have been trained in the best European and American colleges. Consequently, the manufacturers of a particular kind of reinforcement who boldly advertise their wares by stating that their reinforcement saved a reinforced-concrete building in a fire may "get by" in this country, but the chances are that they would not sell a cent's worth in Argentina.

Again, there is a tone of familiarity and paternalism in American advertising which must give very bad results in Argentina, and, more generally, in South America. The ignoramus likes, as a rule, to be patted on the back by the man of verbose oratory and unimpeachable attire, but the intelligent man—especially if he belongs to a race naturally prone to be pompous and punctillious in matters of dignity—must resent the slightest attempt at familiarity.

This fault in advertising is still more accentuated in the case of the living advertisement—the agent. As a rule he is a rushing, pushing, hustling fellow totally devoid of any knowledge as to the history, customs and manners of the country to which he is, in the language of diplomacy, "accredited," but imbued with the idea of its inferiority to the United States. His education and his knowledge of things in general is sadly deficient and his manners, from a South American point of view, leave much to be desired. Being unconsciously aware of his shortcomings he depends for his success on his "personal magnetism" and on a voluminous and uninterrupted stream of "hot air." He does not know that his would-be customer is seldom in a hurry, that he is fond of intermingling business talk with dissertations on sundry topics requiring a fairly good education and that, being somewhat vain and not a whit less patriotic than most Americans, he likes to be flattered about his country and customs. The American agent has to learn this and not until he does so will he be able to make any headway in Spanish-American countries.

Some American firms have issued catalogs in Spanish. These publications are excellent as far as the paper, the printing and the general get-up are concerned, but as they are merely literal translations of the publications issued for home consumption they are permeated with the same paternalism and familiarity already referred to. Moreover, although money is lavishly spent in their paper and printing, their translation is invariably entrusted, with purblind economy, to underpaid students insufficiently acquainted with the language. The result is a hotchpotch which indicates a certain amount of sloppiness on the part of the publishers and which is bound to have a very bad effect on the foreign business man.

The writer has in his possession a handsome catalog in Spanish published by a firm in the Middle West. It must have cost the publisher a goodly number of dollars, for the paper and the printing and the illustrations are excellent, yet the publication is bound to cause an unfavorable impression to a Spanish-American reader, for not only have the cuts been taken directly from the English edition without translating the few words accompanying the diagrams, but there is an average of ten grammatical errors to each page of fifty short lines.

With such methods of advertising is it any wonder that United States trade should have lagged behind in South America?

M. J. Lorente,
With Stone & Webster Engineering Corporation.
Cambridge, Mass.

Drainage Coefficients in the Boise Valley, Idaho, are given approximately as 1 sec.-ft. for each 400 acres drained by J. L. Burkholder, in a paper read before the Idaho Engineers' Society. A recently completed ditch discharges nearly 1 sec.-ft. for each 200 acres drained, but this high duty is probably caused by seepage from a reservoir located above the ditch. Assumptions locating the drainage lines advocated by Mr. Burkholder are: Locate the drain on the upper side of the valley as indicated by the slope of ground water gradient, tapping the water-bearing stratum at the highest possible point; follow straight land lines to facilitate construction and keep out of existing water courses.